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SOME OBSERVATIONS ON CONTAGIOUS MAMMITIS IN DAIRY COWS.

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THE present time appears to be opportune for offering a few observations on the disease contagious mammitis, a subject which is attracting attention throughout the dairying districts of New Zealand, having been brought to the fore by the various cures and prophylactics on the market, more especially by the use of vaccines. These observations are based on the examination of thousands of samples from New Zealand cows, on cultural work in the laboratory, and on watching the course of the disease in experimental animals—giving confidence to express an opinion on many points met with.

CAUSE.

It may be remarked in the first place that the name "contagious mammitis" is really a misnomer, as it will not be contested by any veterinary practitioner that all forms are contagious given certain conditions. Mammitis may be caused by several species of organisms, either singly or together, those which have been definitely found in New Zealand being streptococci, a staphylococcus, and two forms of rod-shaped bacteria. We may ignore the rod-shaped group, and consider the remaining two. Staphylococci are frequently found in the undrawn milk of cows, lying harmlessly in the large milk-sinuses. Staphylococci and the bacillus of abortion, according to one authority, are found more often than are streptococci or chain forms, but this has not been our experience in New Zealand. When inflammation of the quarter has actually developed it is not very frequently the staphylococcus which is found to be present. Occasionally the writer has come across this organism in pure culture, more particularly with goats. Whenever alone causative, it is found in large numbers in the samples submitted, and is obtained in pure culture from the sample taken in aseptic manner. The streptococcus, on the other hand, is far and away the most frequent type to be met with here.

Now, several different varieties of streptococci may be found in mammitis, and the streptococcic form is that which we are used to

hearing called "contagious mammitis." It is known that even the streptococcus of sour milk may set up mammitis, and it appears certain from experimental work that there is a particular streptococcus from the droppings of cows which frequently causes a less virulent form of the disease. The most typical variety, however, is that known as *Streptococcus mastitidis*, which has definite reactions in culture media.

The virulence of the organism found in any one outbreak of the disease is a factor when it comes to controlling that outbreak, but the biggest factor is that of injury to the udder. Injury may be brought about in many and various ways, among which may be enumerated chills, calving, horning, kicks, falls, possibly septic metritis, cow-pox, rough handling of udder, irregular milking, heavy production, and overstocking with milk before calving, but, above all, to machine milking. Certainly contagious mammitis was known before machine milking, but not to the extraordinary extent that it is known to-day through injurious and careless use of the machines. A machine correctly handled is not a source of danger, but undue increase of vacuum, failure to understand the individual peculiarities of all cows in the herd, and also the difficulty with many farmers to keep their machines scrupulously clean, tend by continuous irritation and by combining the two necessary factors in this disease—dirt containing the streptococcus and local injury—to be the source of apparently violent outbreaks of contagious mammitis.

To recapitulate, we have three factors—the streptococcus which is apparently ubiquitous in cow-sheds, the virulence of that organism in a given outbreak, and thirdly, of most importance, injury to the delicate tissues of the quarter.

COURSE OF THE DISEASE.

The majority of cases of contagious mammitis commence as noticeable acute inflammatory reactions in one or more quarters of the udder. In this quarter one usually gets a sudden change in the milk owing to the large number of invading wandering cells from the blood-stream, and owing to an inflow of lymph which will alter the reaction of the milk. In the worst cases inflammation stops the milk-secretion to a large extent, and in place of milk one gets yellow fibrinous clots and an amber-coloured fluid. In milder cases a deposit of cells is found at the bottom of the sample to be examined, the secretion having retained its milky colour to some extent but appearing thin and watery. There is, however, another form which occurs commonly and which is annoying when curative measures are adopted; it is also annoying to the examiner of the sample in that, unless a thorough history of the cow is supplied, he is not absolutely sure of his diagnosis without ample experience; moreover, it is dangerous in that the condition is often not recognized by the milker. By this is meant the common chill which persists as a more or less subacute form of the disease for some considerable time. This type does not flare up into an acute attack when first attacking the quarter, and is, the writer believes, a combination of slight injury to the quarter and slight virulence of the organism. Of recent years this type has been common. But let a quarter such as this be left without milking—as during the drying-off period—then

the disease may often flare up and assume every indication of a really acute form.

Streptococcic mammitis runs one of several courses. In one the number of cells quickly subsides, and the milk reassumes a normal state to the naked eye. This may be due to the individual resistance of the cow or to the fact that a less virulent species of the streptococcus has gained entrance to the quarter. In another form of outbreak the quarters quickly become dry, the fat-cells are ruined, and the quarter becomes hard and fibrous, never again becoming quite normal, although at next lactation there may be some return to milk. A third type results in a fibrous lump forming at the base of the teat-sinus—the popular "pea in the teat." Yet another case will continue to give a secretion rich in inflammatory cells, and obviously affected with the disease, for months or even throughout the animal's lactation period. All these cases harbour the streptococcus.

Where a staphylococcus is found in pure culture or in a rich combination with the streptococcus in an acute case there is often abscess-formation and sloughing of the quarter. When an attack has been running its course for some time one finds that the infection becomes mixed—that is, streptococci are joined by staphylococci, which may help to prolong the condition.

A large number of cases of contagious mammitis appear themselves to subside, with or without treatment, into what may be called a chronic state, in which one gets a few inflammatory cells always present in the cream on standing, and in which cells one may often see microscopically an engulfed streptococcus. These cases—and the writer believes them to be the majority of cases of contagious mammitis—last usually throughout that particular lactation period. Once, however, the cow has dried off successfully without a recurrence of the acute form, the streptococcus, which has been lying almost latent, dies out, and the cow usually comes in with a sound quarter. She may not, of course, give the old quantity of milk, but what she gives is wholesome. As it requires the microscope to demonstrate the case of these cows, and as they are perfectly normal to all outward appearance, the farmer may well understand how dangerous they are in his herd. It is such cows which keep up the incidence of mammitis in the herd.

To show that this view of chronic mammitis is correct an actual instance may be given. Ten cows were known to have had contagious mammitis in definite quarters in the past two to six months, and then, giving only an odd inflammatory cell in the milk, were left over two milkings, except where easement was given to one or two animals which were becoming overstocked. The collection of milk at body-temperature gave the organisms lying latent an opportunity to propagate under ideal conditions. In whichever quarters these cows had had mammitis it was observed that they had a recurrence in the form of a very acute attack, and, what was more significant, only in those same quarters. The previously normal quarters remained normal. The obvious conclusion is that the affected quarters should either have a treatment given which might kill the streptococcus, or else that such quarters should be dried off.

TREATMENT.

The matter of treatment may be dealt with under two heads—namely, curative methods and prevention.

Curative methods so far have not been as successful as might be expected, and many drugs have been tried. The ideal is a drug which could be easily administered and which would be excreted by the udder without harming the cow, but would have a selective harmful action on bacterial life only. No drug of this nature has yet been discovered. Failing such a drug, one can try the next best method, and that the writer believes to be pumping in or otherwise introducing a disinfectant in gaseous form. Provided the disease is taken in time, and the quarter thoroughly stripped by massage to remove clots, some good results have been obtained in many cases by such methods, but even then at least two treatments are found to be more satisfactory, with an interval of about three days between them. There are cures on the market embodying this principle, but even the best of these cannot be held as "cure-alls."

Prevention is truly better than cure. The farmer to a large extent has this in his own hands, and the methods are cleanliness of the shed and utensils, care in handling the cows and milking-machines, and care in buying in cows for the herd. There are many herds throughout the country which never or rarely contract mammitis. Hand-milked herds—including many pedigree herds which do not risk machines, or, if they use them, do so with scrupulous care—often enjoy a welcome freedom from the disease. This is largely due to milking each cow as she requires to be milked, and not treating every one as a machine built on the same pattern.

VACCINES.

The preventive method now before dairy-farmers in the form of vaccine is still in the experimental stage. If inoculation is a means of protecting the majority of cows from mammitis, then one would expect that cows which are actually or chronically affected, and which therefore harbour many millions of organisms, should produce in themselves sufficient immunity to protect themselves from the ravages of the organism in a second quarter. One knows, however, that it is just as easy for a cow already affected in one quarter to be later affected in a second as it is for the primary infection to become established, and that although protective antibodies are produced they are not sufficient to keep the cow from becoming infected. This fact is a definite contradiction to the use of vaccine in connection with streptococcic mammitis.

Experimental work at this Laboratory has given us no feeling of security with the vaccines now in local use. It is said by the advocates of vaccine that the artificial inoculation of the disease into the udder for the purpose of testing is too severe to show protection or otherwise of a vaccine. Suppose, for argument's sake, that this is granted, yet the experiments are particularly valuable in that they show that the length of time for which animals remain affected is not greater in non-vaccinated control animals than in vaccinated, and surely the vaccinated should clean up very much quicker. This is also, to the writer's mind, another point which cannot be overlooked by advocates of the vaccine

method of prevention. Much capital has been made of this Department's method of experimentation, but even though the primary dosage directly placed in the udder was higher than would be the case with natural infection, yet if the control cows can throw off infection as quickly and as effectively as vaccinated cows it is obvious that the vaccinated cows are not benefited to any noticeable extent by the vaccine.

It is not only in the experimental work at Wallaceville and at Ruakura but in the field that we find the vaccine has not been effective in producing the necessary immunity to protect herds. A mass of information has been obtained by officers of the Department, and they find that in a great many cases the cows vaccinated have not received sufficient immunity to prevent infection. This is particularly noticeable in the Wairarapa, and this district, owing to shortage of rain, has not had the flush of milk in the current season which some other districts have had, and without this flush of milk we could not expect the same prevalence of mammitis.

There is a blood test (the agglutination test) which can be applied to a cow's blood to show what amount of a certain antibody is set up by the presence of the streptococci in the system of a cow. The amount set up in experimental vaccinated cows was found to be very much less than where the cows were affected with the chronic form of the disease, these latter cows not having been vaccinated. This would tend to show that a cow chronically affected has a better opportunity of withstanding further invasion by the disease, but, as was stated before, such cows often do become infected in a further quarter. How much easier, then, would it be for the vaccinated cow, with less immunity, to take the disease.

CONCLUSION.

There is one great danger which the farmer should be warned against, and that is the laxity which may follow his belief in a preventive agent against contagious mammitis. Sooner or later he may receive a severe lesson. Should he, on the other hand, knowing the widespread nature of the organism of the disease, keep up strenuous endeavours by cleanliness and watchfulness to avoid his cows becoming infected, then he will correspondingly benefit. The farmer who will have least trouble is he who milks carefully to avoid injury, builds up the system of his cows by good feeding and suitable top-dressing of his land to withstand disease, keeps his utensils clean, avoids risks of infection by strict antiseptic precautions, and buys in only cows free from diseases of the udder.

The presence of certain plants, particularly English trefoil, is a sure indication that the soil is suitable for lucerne-growing. Lucerne requires large quantities of lime, and where the soil is deficient liming must be carried out.

The greater the proportion of total feed consumed by the dairy cow available for production the greater the gross value of every ton consumed. A 150 lb. butterfat cow consumes 15 tons of grass, returning 15s. per ton with butterfat at 1s. 6d. per pound; a 300 lb. cow consumes 20 tons, returning 30s. per ton. Adequate feeding always pays.

MINERAL ELEMENTS IN THE FEEDING OF STOCK.

(Continued from December issue.)

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Calcium and phosphorus are the two mineral elements contained in the greatest amounts in the bodies of all domestic animals. Calcium, it should be stated, is the metal of which lime is the oxide. Quicklime is merely the metal combined with oxygen (which exists freely in the atmosphere), and is analogous to the oxides of other metals, that of iron, for instance, being called rust. Phosphorus, as is well known to many farmers who poison rabbits, is an extremely unstable, non-metallic element spontaneously igniting in air to form oxides, one of which, phosphoric acid, quickly combines in the presence of water with any suitable oxide of a metal to form a phosphate.

It is either one or both of these elements—calcium and phosphorus—which are the most likely of all to be deficient in the diet. Furthermore, it is in special cases in which certain animals which have been highly developed by artificial selection for special purposes that the deficiency often appears. Thus, some breeds of pigs will increase in weight from 2 lb. to 2 cwt. in six months; there are dairy cows which yield in their milk from 10 lb. to 12 lb. of solid matter per day; there are hens which will lay two to three hundred eggs in a year. (Orr.) The demand of such animals for large quantities of energy foods is readily recognized by the fortunate owner, but the necessity for providing an adequate supply of mineral foods is not always realized, nor is it recognized that although plenty of food is given it may not contain enough of the necessary minerals. It may be easier to see that a hen will require quite a large amount of lime to form two or three hundred egg-shells in a year, and for this purpose calcareous foods and grits are, of course, given; but it is not so easy for the farmer to realize that for every 500 gallons of milk sent off the farm there is being sent away 9 lb. of phosphoric acid, or the amount which would be found in ½ cwt. of ordinary superphosphate.

Of course, in economical working much of the phosphate is given in the skim-milk to pigs, and is used by them to build up their quickly growing bodies. The amount of phosphate contained in each pig's body must be allowed for and imported on to the farm. A portion in the excreta of the stock passes back into the soil. Little mineral matter is contained in the cream sent off the farm, so that when this is the practice, and if the excreta of the animals can be properly redistributed (an ideal seldom realized), the home separation section of the dairy industry should be the one which impoverishes the land in minerals the least of any, butterfat consisting of carbon, hydrogen, and oxygen, which are in the first place entirely derived from water or the gases of the atmosphere. As at present conducted, however, one must consider dairying as a form of intensive farming which requires constant application of minerals—particularly phosphates—to the pasture.

What takes place when the elements calcium and phosphorus are deficient in the pasture is that the animal supplies the deficient element from its own bones to make milk or to carry on the body-changes for which phosphates are essential. There is, however, a limit to this store of phosphate, and soon a crisis is reached when the bones themselves, having given up all the reserve store of phosphates, are finally so depleted that malnutrition of the bones appears. This, commencing with soreness of the joints, is followed up by degeneration of the bony structure, the animal becoming a pitiable sight with a limping and unnatural gait. This condition is relieved by medicinally treating the animal with phosphates, or more slowly by top-dressing the pasture with phosphate if there is sufficient rain to carry the phosphates to the plant. In sheep, the bones may actually break when handling the animal.

The importance of giving a salt lick to all farm animals is universally recognized. There may be some areas near the sea where this practice is unnecessary, and the animals will probably refuse to lick the salt. Among other functions salt supplies sodium and chlorine, both essential mineral foods. It is supposed that the sodium assists in the elimination of potassium, which exists in such abundance in all green pasture and especially in the young growing grass. The potassium is excreted in the urine by stock, and is thus largely returned to the pasture whence it was derived. No case of potassium being deficient is on record, though an excess of it may be injurious, and there is at least one instance attributable to this cause in the literature of the subject. The chlorine is required by the animal to make hydrochloric acid, which is the acid of the digestive juice. It is not possible to say whether recognizable symptoms are peculiar to and would follow a deficient supply of salt, but a supply of salt lick will usually be found beneficial in promoting an increased thriftiness and condition in stock, while the reverse of this may be the case if salt is withheld.

The function of magnesium in the animal economy is not definitely known. The amount present in milk is relatively small; apparently in animal nutrition it bears the same relation to calcium as potassium does to sodium. Professor John Malcolm has shown that the introduction of soluble magnesium salts into adult animals causes a loss of calcium. Abderhalden states that in osteomalacia, a form of bone malnutrition, a certain antagonism between calcium and magnesium salts has come to be recognized.

Iron, although present in small quantities compared to the other mineral elements in the animal-body, is none the less essential, and when deficient gives rise to symptoms which are unmistakable. It has been found that sows fed on a diet deficient in iron produced young which suffered from iron-starvation, which was attributable to a lack of iron in the milk (McGowan and Crichton, *Biochemical Journal*, No. 1, 1924). The distinction in the symptoms of a ruminant suffering from deficiency of phosphates and another from deficiency of iron is well marked. In the case of phosphates it is the bones which show signs of being affected. In the case of iron the blood is deficient and the animal anæmic (showing lack of blood). The bones of such an animal are quite normal, and there is no soreness of the joints causing

the animal to limp. It is fortunate that these deficiency diseases which are commonest in New Zealand are so well marked in their symptoms as to be unmistakable.

There are other elements, such as fluorine, iodine, manganese, copper, zinc, and arsenic, which are normally found only in traces in the bodies of animals, and most of them are now held to be essential in small quantities. Farmers will be familiar with all of these except fluorine and manganese. Fluorine is the lightest member of the group of elements called the halogens or "acid-makers." Chlorine, as stated, is necessary to make the digestive-acid juice, hydrochloric acid, the other members being bromine and iodine. Fluorine is a colourless gas, and it is always found in the bones and teeth of animals in the combined state. Iodine is an element which has come into great prominence in connection with the cure of goitre. No extensive deficiency in New Zealand domestic animals has been observed which might be attributed to deficiency of iodine. Isolated cases of goitre have, however, been observed in dogs and horses.

Manganese is abundantly distributed in all parts of New Zealand in the soil and pasture. There is no suspicion of its being deficient. In some places it may be in excess. Where this is so it is likely to be met with in the form of a black compound, the dioxide of manganese sometimes found in the form of black nodules in the soil.

MEDICINAL MIXTURES AS LICKS.

The question which will immediately occur to the reader is, Cannot any minerals found deficient be supplied in the form of a lick? The writer went into this aspect of the matter when in England, and cannot do better than quote from Dr. Orr on this matter. He states in "Importance of Mineral Matter in Nutrition," under the heading of "The Value of Salt Mixtures,"—

"During the last two or three years various salt mixtures have been advocated, and some put on the market. It must be obvious to the intelligent reader that, though these may do good in some cases, they do not solve all the difficulties of an adequate mineral-supply. In some cases, indeed, they may do harm. For example, a salt mixture rich in phosphorus would show excellent results if added to a ration poor in phosphorus, but would do harm if added to one with a surplus of phosphorus. Salt mixtures intended to be used in a routine way with all the different kinds of rations likely to be fed are quack remedies of doubtful value. There is no short-cut to the perfect feeding of animals. The feeder must know the requirements of his animals, and the extent to which different feeding-stuffs will meet their requirements, and then arrange rations accordingly. The research worker may ultimately be able to supply him with the necessary technical information to do this. But he will never be able to supply him with a salt mixture that will relieve him of the necessity for making his own calculations and coming to his own decisions as to what is best for the animal in each case. Indeed, that is where the skill and experience of the feeder comes into play."

This must not be taken to imply that rock salt or licks supplying common salt alone should not be used. This is a farm practice which

has proved itself and has now become general. Neither must it be taken that if iodine or any other element is found deficient it must not be supplied in lick form. Each case must be decided on a knowledge of all the circumstances, but it is unlikely that a general lick for all cases will be found satisfactory.

2. DRINKING-WATER.

In the December issue of the *Journal* it was shown that the substances eaten by stock could be classified into two groups—namely, those which by their oxidation in the animal supplied it with warmth and energy, and others, the no-less-important non-combustible or mineral ingredients of the food, which, although not supplying warmth and energy, were true foods, and as vitally essential to the health and growth of the animal as the combustible compounds of carbon, hydrogen, nitrogen, and sulphur comprising the first group.

There is another substance, however, which, although neither a combustible material nor a mineral food, is swallowed in large quantity and is just as necessary to the well-being of the animals as either of the above groups—namely, water.

The necessity for water is so generally recognized that the books on feeding say little about the necessity for a good, pure, permanent supply of drinking-water for stock on the farm. So essential is water that if stock were wholly deprived of it they would die quicker than if they were given plenty of water and wholly deprived of food. (Green pasture contains 75 per cent. of water, so that this is really a mixture of food and water.)

Water plays a very important part in the animal economy; about two-thirds of the weight of the body consists of water, and every cell, to be kept at a definite consistency, must contain water, which the organism requires for a number of different purposes. Water facilitates the chewing and swallowing of the food; when the food is digested, water is necessary to dilute the products and enable the soluble nutrient bodies which have been formed to be absorbed. Should the solution of these be too concentrated it will not penetrate the walls of the alimentary tract, but rather will draw water from them, causing increased movement of the intestines (peristalsis), premature evacuation, and hence loss of unabsorbed nutrients. Water serves as a transporting agent of the nutrients in the blood and lymph vessels, and also carries off much of the final waste products which the organism produces. By evaporation from the skin and lungs water provides the animal with the most valuable means of regulating the temperature of the body. If sufficient water is not present in the body to cool it by bedewing it with perspiration fatal overheating may occur after severe muscular work or overfeeding.

Observations on men and animals show that when water is deficient gastric digestion and absorption of digested substances are hindered; nitrogenous products are not sufficiently rapidly excreted from the body. In continued lack of water the blood thickens and the temperature rises; a condition similar to fever then occurs, and young growing animals can easily be injured in their development by even a moderate lack of water or by irregular watering. On the other hand, there is

little fear of animals receiving too much water unless they are given excessive quantities of watery foods, or too great a thirst is induced by the eating of large quantities of salt.

If the deficiency of drinking-water becomes too acute the result may lead to digestive disorders in stock. In cattle, impaction of the rumen may occur when the weather is dry and water scarce. When this condition arises and becomes chronic a plentiful supply of drinking-water must be available for its proper treatment. Insufficient drinking-water of indifferent quality, which the stock will not freely drink, materially assists in producing impaction of the rumen. Lack of water is a potent source of constipation in stock, and the drinking of impure water is responsible in some cases for diarrhœa. Water contaminated by mineral irritants (sheep-dip, &c.) may provoke inflammation.

In experiments where animals have been allowed to drink as much water as they wish the quantity relative to the dry matter eaten is found to be fairly constant. For 2½ lb. (1 kilogram) of dry matter pigs were found to consume seven to eight times, cows four to six times, oxen four to five times, and horses two to three times the amount of dry matter taken. Large quantities of very cold water given all at once are not so useful as smaller quantities given throughout the day. The water, if feasible, should be at a temperature of from 50° to 60° F., and it is desirable that it be chosen from as pure a source as possible.

It is important that a plentiful and good supply of drinking-water should be provided for milking-cows, more especially in the hot summer weather, in order that the animals should yield well. According to Geneva (New York) experiments with seven breeds, about 5 lb. of water are required for every 1 lb. of milk yielded. In this country of abounding water it would be regrettable were the shortage of drinking-water to constitute one of the factors in diminishing the milk-yields, but it is feared that the matter has not always received the consideration which the importance of the subject warrants. The following articles published in this *Journal* may be referred to: "Water-suppply on the Farm: Utilizing Springs," by J. D. Ritchie (Vol. 12, p. 361, 1916); and "Concrete Water-tanks," by the Public Works Department (Vol. 20, p. 114, 1920).

(To be continued.)

Noxious Weeds Orders.—The Lake County Council has declared broom and gorse to be noxious weeds within that county; Pohangina County has similarly declared foxglove.

Reconditioning a Galvanized-iron Tank.—A correspondent asks for advice in repairing a galvanized corrugated-iron tank that is becoming full of pinholes. The following method will be found effective: Make a cement wash by mixing pure cement and water to a consistency of an ordinary whitewash preparation. Apply three coats to the interior of the tank-walls, allowing each coat to dry before applying the succeeding one. When the walls are dry, pour the wash into the bottom of the tank to the depth of ¾ in., and stir well to free from bubbles. Care must be taken to keep the sun off the tank while drying, as heat will at once disintegrate the cement-particles when in the drying stage, the cement falling away as a powder. If care is taken in this respect during treatment the tank should be good for several years' use.

WALNUT-CULTURE.

SOME NOTES ON HAWKE'S BAY GROVES.

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IN order to meet the growing demand in this Dominion for nuts, importers increased their purchases of foreign nuts for the year 1924 to a total value of £81,000, the estimated value being that in the country of origin at the time of export plus 10 per cent. The inquiries received from growers in different parts of the Dominion show that they also are taking an interest in this demand, especially the walnut section of it.

FIG. 1. WALNUT GROVE AT RIVERSLEA, HASTINGS.
These trees are 40 ft. apart and twenty-eight years old.

With a view to obtaining a better estimate of the well-known difficulties which the walnut-growers in the Dominion have to meet, a special inspection was made recently of the walnut groves in Hawke's Bay. One of the largest there is that on the Riverslea Estate, belonging to Mr. E. H. Williams. The main grove is $5\frac{1}{3}$ acres in extent, the land being a good well-drained alluvial loam, and the trees seedlings planted twenty-eight years ago at a distance of 40 ft. between trees and rows. About an equal number of trees are distributed round orchard headlands and employed in forming a considerable avenue. These trees, two to three hundred in number, afford many interesting comparisons.

While the Riverslea crop this season generally is heavy, a few trees, though in usual health, are carrying a very small crop. Others again have exceptional loads. As regards the walnut-blight (*Pseudomonas*

juglandis) that is the despair of so many growers (infecting the crop in early spring and ruining the young nuts before they can develop), it was at first supposed not to be present, but just before the inspection was completed one tree was found with practically the whole crop rather badly affected. The health of the other trees in the grove was excellent and the nuts fully developed, but, of course, immature.

FIG. 2. WALNUT-TREE AT RIVERSLEA, SHOWING THE ADVANTAGE OF WIDE SPACING.

This tree, having the advantage of being next to a gap in the rows, is carrying a heavy crop round the sides as well as the top.

Inquiry brought out the fact that this bacterial trouble, which fails to respond to spray and ordinary treatment, varies greatly in the severity of its attack.

Although the crop at Riverslea this year is practically clean, in other seasons the proportion of loss has been very high. The best

conditions appear to be a wet winter and a dry spring, when trees on such land as this may be expected to make a good return. Yet in the worst seasons for walnut-blight two or three trees in this grove can be relied upon to ripen their crop 90 per cent. clean. These remarks apply to the so-called English walnut, which forms practically the whole of the planting. A few Japanese walnuts, showing great

FIG. 3. WALNUT-TREE AT RIVERSLEA, SHOWING THE METHOD OF TRAINING THAT HAS GENERALLY BEEN ADOPTED.

vigour and carrying fair crops here, have never been known to be affected with this disease in the experience of the present manager. Unfortunately, the kernels are so small and difficult to extract from the exceptionally hard shells that they are not a commercial product.

A number of other groves visited on the Heretaunga Plain, and carefully inspected, endorsed the foregoing evidence. Heavy, clean

crops were the rule, and not another badly blighted tree was found, although owners admitted that in some seasons the crop was a serious loss.

The practice generally has been to obtain seedling trees from the nursery, where they have been grown from seed obtained from a tree selected for its constitution and the quality of its nuts. In view of the increasing commercial importance of this crop and the more ex-

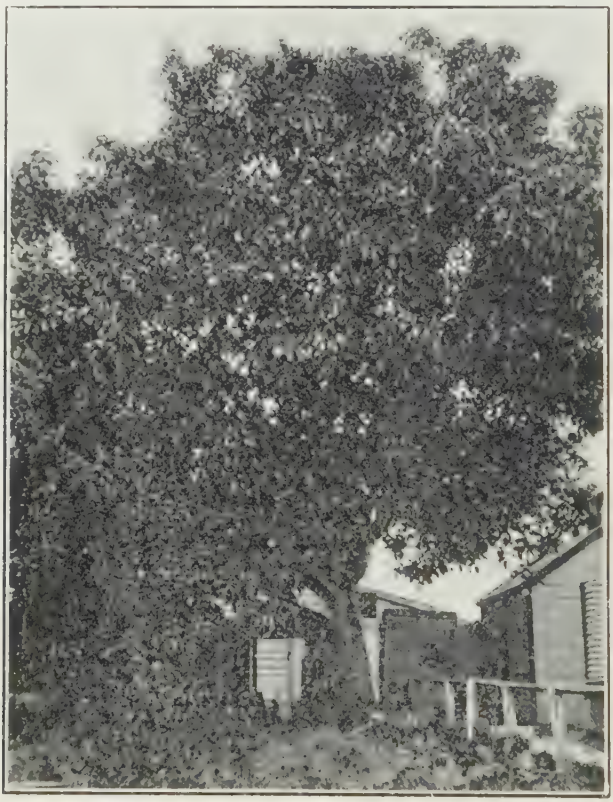


FIG. 4. WALNUT-TREE AT J. TAYLOR'S ORCHARD, HAVELOCK NORTH.

A good cropper of excellent nuts, used as seed for commercial propagation.

tended planting taking place, it would doubtless be wise now to carry the nursery process a step further and graft these stocks over in the spring with a variety such as quoted, that, besides being of good quality and cropping, averages 90 per cent. clean nuts in a season when walnut-blight is epidemic. There would be the further advantage of having an even sample at all times, which is indispensable in maintaining a business connection. Every large grove has a tree or two of outstanding merit. These should be marked and studied by comparison with other such trees in the locality. Along these lines considerable progress can

be made, as in other countries where walnut-culture is an industry of any importance.

Planters should note that a fully grown walnut-tree will cover a circle 40 ft. to 60 ft. across, and to obtain the maximum cropping-surface the trees must not touch, as branches that are shaded by interlocking remain barren. In the drier districts trees grafted with a variety proved in the locality can be recommended for planting on

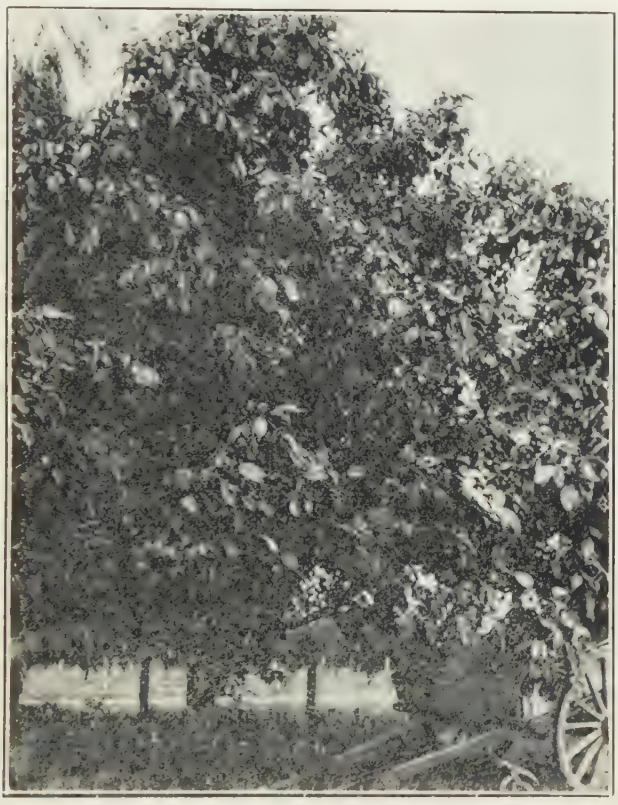


FIG. 5. AN OUTSTANDING WALNUT-TREE AT S. A. JARVIS'S ORCHARD, TWYFORD, HASTINGS.

Of one hundred or so walnut-trees planted round the orchard seventeen years ago, two are outstanding for constitution and cropping, one being the tree here shown.

good alluvial land, either on the margin of the leeward side of an orchard or garden, or as an avenue, for which the walnut is very suitable. The trees should be staked and the land cultivated, at least until the trees come into bearing; where planted in blocks, inter-cropping is usually carried on until that stage is reached. For the purposes of standard grading, which is so helpful in the marketing of a crop, it is desirable to confine the planting in any one locality to as few varieties as possible.

NEW ZEALAND AGRICULTURE.

ITS TREND IN THE PAST QUARTER-CENTURY.

In his presidential address to the Agriculture Section of the New Zealand Institute Science Congress held at Dunedin last month, Mr. A. H. Cockayne, Director of the Fields Division, Department of Agriculture, discussed the trend of agriculture in New Zealand since the year 1900. Following is the main part of his remarks on this subject :—

The area from which agricultural production takes place in New Zealand can be roughly divided into three main groups—the tussock grassland, the sown grassland, and the annually cropped land. In 1900 there were about 15,000,000 acres of tussock grassland, nearly 11,000,000 acres of sown grassland, and a little over 1,500,000 acres of annually sown crops. In 1925 tussock grassland remained between 14,000,000 and 15,000,000 acres, sown grassland had increased by 6,000,000 to nearly 17,000,000 acres, and annually sown crops were a little under 1,500,000 acres. It is therefore the 6,000,000 acres increase in sown grassland—of which the North Island claims 5,000,000 and the South Island 1,000,000 acres—that marks an essential feature of the development of New Zealand agriculture during the past twenty-five years. In the South Island the 1,000,000-acre increase has been derived partly from lowland tussock grassland, partly from forest, and partly from land previously under short-rotation cropping. In the North Island the major portion of the 5,000,000-acre increase has been from forest, and partly from the reclamation of swamp lands. The average annual rate of increase—about 270,000 acres—is rapidly shrinking, however, and the time when from 300,000 to 400,000 acres of grassland might yearly be added by axe and match has now gone by. The bush-burns of the future will be more in the nature of recovering grassland already sown, where nature is reasserting itself, than in displacing virgin forests with pasture.

There still remain, however, three great areas from which to draw our future increase in sown grasslands. These are much of the lowland tussock country, the pumice plains, and the heath-covered gum lands of the North. The last two will in the next twenty-five years add a large annual quota to the sown pasture of New Zealand ; but in the past, while good forest country was available that could be cheaply grassed without the intervention of the plough, these great potential sources of grassland increase have been largely neglected. The work of the Department of Agriculture at Puwera has shown that on the gum lands of the North alone an increase of a quarter-million cows is quite reasonably to be expected. Without doubt, however, the future is concerned very largely with improvement both in the productive capacity and the utilization of the area already in grass.

During the period under review the development of dominance of danthonia and agrostis species over very wide areas not originally sown with these grasses, and the consequent problems involved in the management of both these types of induced vegetation units, is the most noteworthy grassland ecological feature so far as acreage involved

is concerned. Again, the development of paspalum as a major dominant over large areas in the North is one of the outstanding features.

In 1900 perennial rye-grass was the dominant seed sown under all conditions of soil and climate; but at the present time, with the exception of especially fertile soil and where a short-rotation pasture is intercalated between the growing of a series of annual crops, the tendency has been to reduce the amount sown. The first great change with which I was closely associated was the effort to make cocksfoot the dominant element on land which was below a permanent rye-grass standard. This has not been wholly successful, and an earlier knowledge of the ecological requirements of this grass would have saved much heartburning on the part of many farmers.

Paspalum, Western Wolths rye-grass, Lotus major, and Lotus hispidus can be ranked as the main new pasture species that have secured a permanent position, while subterranean clover is on the eve of winning a similar place. Crested dogstail, comparatively rarely used in 1900, is now general in the North Island, and amounts such as 3 lb. to 4 lb. in mixtures for hill country are now employed. The fall of Chewings fescue as the invariable subdominant in poor land sowings, except where seed-production is aimed at, is also one of the features of the period. The use of Italian rye-grass, both in short- and long-duration leas, has increased.

Of recent years the recognition that imported white clover is temporary and colonial white clover tends to be permanent, also the realization that unless by cultivation, manuring, or other process poor land can be raised to the fertility demanded by rye-grass, cocksfoot, or crested dogstail, dominance by a third-class grass, such as brown-top or danthonia, must be aimed at, have been salient features in grassland establishment.

During the period many pasture plants have been tried and found wanting. Among these Phalaris bulbosa, teff-grass, awnless brome, tall oat-grass, and prairie-grass are perhaps the most significant. For a period the "deep-rooted" system of Elliott threatened to influence pasture methods in New Zealand, and had it not been for the fact that tall fescue (of unenviable fame in this country) ranked as important in his sowings the system would have enjoyed great temporary repute. Even now chicory and sheep's burnet are found in some of our pastures, relics of the vogue that set in for a while.

Immense problems confront the investigator before the standardization of methods of grass-farming can be attained. Until quite recently the dominance of grassland was largely viewed as representing only a temporary phase in our agricultural development, to be completely modified before long by the introduction of more intensive methods of soil utilization in which the annually sown live-stock feeding crop would steadily increase in importance. In actual practice such has not been the case, and the factor of top-dressing grassland is definitely swinging the pendulum of agricultural practice along the line of less reliance being placed on annual crops, and increased reliance on methods of pasture manipulation and pasture management.

The basic feature of grassland from the management standpoint is the fact that its production is seasonal, rising to great heights during

portion of the summer and falling away at other periods. In other words, the seasonal stocking capacity of grassland varies enormously. Grassland stocked on the basis of its low-production period means an enormous wastage of feed during the high-production period, and the art of grass-farming consists of the maximum economic utilization of the whole of the feed produced. There are four great methods whereby this can be carried out, or attempted to be carried out. They are: (1) Buying stock when feed is plentiful, and selling when feed is scarce; (2) varying the feed requirements by a maximum employment of female animals; (3) overstocking when feed is scarce, relying on rebuilding up weight when feed is plentiful; (4) providing ample supplementary feed, either farm-grown or purchased, to fill in the low-production periods of grassland.

The first method appears wholly bad, but is still regularly made use of by the grass-farmer.

The second method is the most significant one that has been developed during the past twenty-five years. The winter stocking, excluding horses and pigs, at the present time is somewhere about 40,000,000 units*; but the summer stocking, using the same units and their offspring, is nearer the equivalent of 60,000,000 units. In 1900 there were 9,000,000 breeding-ewes, now there are 13,000,000; while the number of sheep wintered is not more than 5,000,000 above that of 1900. Since that date 1,000,000 cows have been added to our dairy herds, and the system of a short lactation period results in a high grass-utilization, corresponding with the period of maximum grass-production. Both the development of our dairy industry and our frozen-meat industry is based on varying the feed requirement to coincide with the rise and fall in grass-production. The exploitation of the maternity of live-stock is, in my mind, the outstanding feature of our progress—if it can be termed progress—of the past quarter-century.

The third method, of overstocking and allowing losses in weight, has many followers; but they are not prepared to admit that it is their intentional practice. It frequently leads to an apparently satisfactory result, unless overdone by automatically lessening summer grass-production, resulting in a spurious high utilization of the feed produced.

The fourth method, of supplying abundant supplementary feed, has been constantly reiterated by the farming community; but let us see what has actually happened. In the first place, however, it is necessary to point out that North Island farming and South Island farming are essentially different from the supplementary feed point of view. In 1900, 1 acre of supplementary feed was grown to every 23 stock units in Canterbury, Otago, and Southland; in the North Island 1 acre to every 110 stock units. To-day 1 acre is grown to every 25 units in those South Island provinces named, and 1 acre to 150 units in the North Island. The acreage certainly has increased, but not in proportion either to the added grass acreage or the increase in stock. In 1900 there were about 25,000,000 stock units; to-day there are over 40,000,000, and the carrying-capacity has increased from 1·6 stock units per acre of sown grass to 2 stock units per acre, an increase of

* The term "stock unit" as here used is based on sheep. One cattle-beast is reckoned as equivalent to five sheep.

25 per cent. in carrying-capacity, with a reduction in the number of acres of supplementary crop grown per 100 acres of grassland. The question that naturally arises is whether this tendency is a sound one economically, and it cries aloud for extensive and critical examination of farm-management practices throughout New Zealand. There is, in fact, no more pressing and urgent agricultural research work needed than that which comes within the scope of farm economics, and this is the very type of work that has been avoided in the past. It is freely admitted that all agricultural research work is of permanent benefit to our primary industries; but to me it would appear that proper farm economic studies are of such pressing national importance that their consummation cannot be safely neglected any further in our agricultural history. Fundamental as they are to a realization of sound land-values and rational development of any agricultural credit schemes, they demand our earnest attention.

So far as annually cultivated crops are concerned, the period under review has marked a steady decline in the production of those cash crops coming under the cereal group. Whereas in 1900 our cereal exports exceeded in value those of dairy-produce, to-day we do not supply our local requirements in cereals, and the dairy export figures have risen from less than £1,000,000 to nearly £20,000,000. The fall in cereal-production has been most pronounced with regard to oats, the lessened production being accompanied by a lessened demand. For wheat, on the contrary, the demand has increased, but production is steadily diminishing, and there is a widespread feeling that the acreage will continue to decline. The standardization of Solid-straw Tuscan as the dominant wheat in New Zealand, the work of Dr. Hilgendorf at Lincoln in pure-race selection, the rise of Algerian oats within the range of severe crown-rust infestation, and the use of the term "Gartons" for all white oats of the grain-producing types are outstanding features in our cereal history of the period.

In supplementary crops, turnips and rape still, as in 1900, dominate the position so far as acreage is concerned, but disease and insect pests have in many districts become serious limiting factors in the successful production of these two crops. This is leading to an increase in such crops as chou moellier, and has particularly influenced the acreage devoted to green oats. The most outstanding feature has been the capture of the turnip and root-crop seed trade generally by the high-priced packet in place of the open market seed of the past. Mangolds and carrots bid fair to increase in acreage, but it is only in certain districts that such is really noticeable. One of the most outstanding of the new crops is Japanese millet, which owes its rapidly attained popularity almost entirely to the fact that it can be managed in exactly the same way as young grass. In the fodder-crop group the extension of Italian and Western Wolths rye-grass for milk-production in ewes is noticeable.

One of the most outstanding features of the period under review is the increase in the use of artificial manures. In 1900, with an annual crop acreage of a little more than at present, somewhere about 25,000 tons of artificial manures—apart from freezing-works material—were used each year, half of this being bonedust. Almost the whole of this material was used on annual crops. To-day over 200,000 tons of

artificials are used, of which more than two-thirds are for top-dressing grass land. Approximately half the manure used is superphosphate, with basic slag second on the list, closely followed by ground rock phosphate, generally in combination with a more soluble form. The area of grass-land now being top-dressed each year just exceeds 1,000,000 acres, or just on 5 per cent. of the sown grassland. The increasing of this proportion, to my mind, represents the great advance that will be made in the next decade, when the acreage annually dealt with should be at least trebled.

With the advance in the use of artificial manures but little progress has been made in exact knowledge as regards the comparative efficiency of individual fertilizers. Our knowledge of the economic value of potash and nitrogen remains much as it was in 1900. Both are often used in combination with phosphates, but whether they are worth while is still highly problematical. In this connection the field-trial work of the Department of Agriculture should finally yield definite and reliable results.

During the whole of the period under review the advantages of liming have been reiterated by all connected with the land. The annual quantity used exceeds 100,000 tons, almost wholly crushed limestone. Remarkable to relate, even when facilities are available it is only in certain districts that liming is an important feature. Over 60,000 tons of the total are used in Southland. The great majority of soil analyses show lime deficiency. Lime has been tried intermittently over the whole of New Zealand by farmers, but the practice has stabilized only in certain districts.

THE BETTER-FARMING TRAIN IN VICTORIA.

Mr. J. W. Deem, Instructor in Agriculture, who recently visited Australia, supplies the following note on this activity of the Victorian Department of Agriculture :—

The train consists of from ten to twelve carriages and trucks painted yellow and labelled in big letters "Better-farming Train." The carriages are fitted up to contain exhibits and models of the various branches of agriculture. One, for example, is devoted to fruit-spraying machinery, grading models, &c.; another to farm crops, grain exhibits from manurial trials, models of silos, &c.; while others contain farm live-stock. In addition to agricultural exhibits there is a carriage fitted up for a mothercraft and infant-welfare nurse, and another for home economics. The live-stock are usually borrowed from private owners, and an endeavour is made to get animals with a reputation for butterfat-production or show-ring success. In the case of dairy cows in milk, the owner usually accompanies the train.

Various experts of the Agriculture Department, &c., accompany the train and give lectures and advice. The nurse and lecturer on home economics remain in their carriage, but the agricultural officers lecture on the platform, or in the goods-shed if the day is wet or cold. The train usually pulls up at a station in the forenoon, remains until 8 or 9 o'clock at night, and then moves on to the next centre. The agricultural lectures are short, averaging about twenty minutes. No questions are allowed, but when the lecturer has finished he goes back to his exhibit on the train, where farmers may meet him and ask questions or discuss any matter connected with his branch of agriculture. One of the carriages is fitted up for lantern lectures in the evening. The train is really a travelling agricultural exhibit with lecturers in attendance, and must serve as a good introduction between agricultural officers and farmers.

TESTING OF NEW-ZEALAND-GROWN WHEATS.

RESULTS FOR YEAR 1925.

(Concluded.)

L. D. Foster, B.Sc., Analyst, Chemistry Section, Wellington.

IV. QUALITY OF FLOURS.

It would be out of place to give in the *Journal* more than a very brief outline of the chemical methods of judging the strength of flours; the following brief survey and the results obtained from some flours milled in 1925 from New-Zealand-grown wheats may indicate, however, the importance of certain lines of progress. These results are additional to the general routine analyses and baking tests of flours given in Parts II and III of this series, published in the *Journal* for December, 1925, and January, 1926, respectively.

The factors controlling in varying degree the strength (or quality) of flours are now considered to be: (1) The *quantity* of the gluten present in the flour; (2) the *quality* of the gluten present in the flour; (3) the "active" acidity, or hydrogen-ion concentration, of the flour; (4) the enzyme activity of the flour. Without at present going into any detailed descriptions it is best for the sake of clearness to enumerate these factors now and to refer to them later in greater detail.

In Parts II and III the connection between quantity of gluten (or protein) and baking-value has been discussed. The *quality* of gluten is, however, a more difficult factor to measure. Gluten of good quality is supposed to be creamy in colour, elastic, and cohesive, and is judged accordingly; poor gluten is greyish, sticky, and lacking in cohesion. A description of a visual inspection of different glutens was included in Part II. This is one of the oldest methods of judging strength, and though it has been completely condemned in certain quarters (4) there is no doubt that at times it is of considerable use.

(*a.*) HYDRATION CAPACITY OF GLUTEN.

Purely chemical methods of determining the quality of gluten have not proved satisfactory, but physico-chemical methods are at present attracting considerable attention. Amongst these latter are methods due largely to Sharp and Gortner (3) in the United States, and to Luers and Ostwald (6) in Europe, who have found a relationship between the viscosity of flour-in-water suspensions and baking properties. These results indicate that flour-strength is connected with the colloidal properties of the gluten. A consideration of the colloidal state is too large a subject for these pages, and the properties of colloids cannot be suitably outlined in the *Journal*; it will suffice to say that gluten exists in the dough in the colloidal state. It must be added, however, that very recently Blish and Sandstedt (1) have said that they found no practical connection between viscosity and baking-value; and that Luers (6) applied these determinations only to flours obtained

from wheats grown in the same locality. It may be stated here that these last two papers came to hand after the results given in this paper had been completed.

Viscosity determinations require the use of special apparatus, but Gortner and Doherty (4) have shown that viscosity is intimately connected with the degree to which a gluten will take up water under certain conditions. This power of taking up water varies with glutens of different quality; a good gluten is said to take up a large quantity, a poor gluten a smaller quantity of water. The amount of water thus taken up under certain definite conditions is called the "hydration capacity," or degree of imbibition, of the gluten.

The method followed with the New-Zealand-grown flours was that described by Gortner and Doherty (4). The results were calculated as the number of grams of water taken up by 100 grams of wet gluten standing in N/50 hydrochloric acid for fifty minutes; the results are therefore expressed as percentages. A varying degree of success was obtained, though undoubtedly this method gives, with certain notable exceptions, some indication of strength; on an average, perhaps, the stronger flours examined contained glutens with hydration capacities higher than the weaker flours.

The following table divides the different varieties into two series, one showing samples with a hydration capacity above 50 per cent. and the other those below 50 per cent.:—

Table 7.—Samples with Hydration Capacities of more and less than 50 per Cent.

Above 50 per Cent.			Below 50 per Cent.		
Sample No.	Variety.	Hydration Capacity.	Sample No.	Variety.	Hydration Capacity.
S 773	Velvet Ngapara ..	76	S 776	Zealand ..	49
S 769	Marquis	75	S 708	Tuscan	48
S 777	Red Fife ..	60	T 78	Durum	48
S 711	Tuscan	60	S 710	Tuscan	44
T 50	Marquis	59	S 771	Velvet	43
T 37	Velvet	58	S 767	Queen Fair ..	43
T 75	College Hunter's ..	55	S 709	Tuscan	42
T 56	Solid-straw Tuscan	55	S 712	Tuscan	40
S 775	Yeoman ..	53	S 774	Essex Conqueror ..	39
S 714	Velvet	53	S 768	Major	39
S 765	Jumbuck ..	52	T 101	Hybrid W ..	39
S 766	Queen Fan ..	51	T 76	Velvet	37
T 51	Major	51	S 778	Hybrid W ..	32
T 77	Solid-straw Tuscan	51	S 779	Scandinavian ..	14
			S 772	Snowdrop ..	10

Undoubtedly there is in Table 7 a fairly complete division between those varieties generally considered to be strong wheats, and weaker varieties. For instance, the strong wheats Velvet, Marquis, Red Fife, and Yeoman are all found in the first column. The varieties from Gore—T 50, 51, and 52—which possessed better baking properties than their protein content indicated, but which contained gluten of

average quality as determined by visual inspection, are also classed among the stronger samples. At the same time it must be pointed out that most of the samples from Lake County, which also possessed better baking properties than their protein content indicated, but which possessed gluten of *good* quality when judged by appearance, are included among the weaker varieties. Moreover, several samples with very low hydration capacities produced quite good loaves from the point of view of volume. These samples were Essex Conqueror (S 774), Scandinavian (S 779), and Snowdrop (S 772). (See column 7, Table 9.) In this series of wheat-flours, therefore, the hydration capacity was not related to any marked extent with the loaf-volume. One must remember, however, that only glutens containing the same amount of water—that is, samples with the same wet to dry gluten ratio—can be fairly compared. It is true, too, that it would be fairer to compare only the wheats grown in the same districts and corresponding approximately in protein content; but even when the Ashburton Experimental Farm wheats are considered we find that Scandinavian, with a hydration capacity of only 14 per cent., made a better-sized loaf than Yeoman with 75 per cent. These two samples each contained 13·75 per cent. protein, so may fairly be compared. Some other factor than hydration capacity is obviously concerned here with baking-value.

A closer relationship, however, was found between the texture of the loaf and degree of hydration of the gluten. The following table consists of samples with fairly high and fairly low degrees of hydration, together with a description of the texture of the loaves made from them :—

Table 8.—Connection between Hydration Capacity of Gluten and Texture of Loaf.

Better Texture.				Poorer Texture.			
Sample No.	Variety.	Degree of Hydration.	Texture.	Sample No.	Variety.	Degree of Hydration.	Texture.
S 773	Velvet Ngapara	76	Good.	S 768	Major ..	39	Good.
769	Marquis ..	75	Good.	774	Essex Conqueror	39	Fair.
777	Red Fife ..	60	Very good.	T 101	Hybrid W ..	39	Medium.
711	Tuscan ..	60	Good.	76	Velvet ..	37	Medium.
T 50	Marquis ..	59	Good.	S 778	Hybrid W ..	32	Good.
37	Velvet ..	58	Good.	392	Durum ..	26	Fair.
75	College Hunter's	55	Good.	779	Scandinavian ..	14	Poor.
52	Solid-straw Tuscan	52	Medium.	772	Snowdrop ..	10	Medium.

A fairly complete separation may be made here—a separation which is very consistent considering the difficulty in some cases of arriving at even an approximate measure of texture. Finally, with regard to the foregoing method of determining strength, it may be said that the hydration capacity of the New Zealand wheats tested in 1925 was only moderately connected with loaf-volume, but was more closely connected with loaf-texture.

(*b.*) "ACTIVE" ACIDITY OF DOUGHS, OR pH VALUE.

It is an old and often quoted fact that sour milk mixed in the dough sometimes improves the baking-qualities of a flour. This improvement is probably brought about by the increased "active" acidity of the dough, due to the presence of the lactic acid in the sour milk.

Active acidity is quite a distinct term from *total* acidity; two acids of the same strength (*i.e.*, of the same total acidity) may differ quite considerably in their active acidity. If we take equivalent solutions of, say, hydrochloric acid and lactic acid (the acid present in sour milk), the former tastes more sour than the latter. The reason for this is briefly as follows: Acids are said to tend to throw off hydrogen ions;* strong acids show this tendency to a marked degree, weak acids to a much more limited extent. As only the hydrogen ions taste sour, a solution of hydrochloric acid (which is a strong acid and throws off hydrogen ions to a marked degree) therefore tastes very sour. Lactic acid (a weak acid) throws off ions to only a limited extent, and tastes only slightly sour. Even though lactic acid is a comparatively weak acid, it is well to remember that it is nevertheless capable of producing, under certain conditions, a small but important number of these hydrogen ions.

To this concentration of hydrogen ions—that is, to the number of hydrogen ions thrown off—the "active" acidity of any acid is due. The concentration of hydrogen ions is therefore the correct term to use, though "active" acidity, as distinct from "total" acidity, expresses the same idea quite clearly.

It has been found expedient to use a system of stating the concentration of hydrogen ions which at first sight may appear confusing. Without going into details, the system is briefly this: The concentration of hydrogen ions is denoted by the symbol pH, in numbers from 1 to 14. The exactly neutral point is denoted by pH 7·0; the *lower* the number is, the *more* acid is the solution; the higher it is, the more alkaline is the solution.

ENZYMES AND ENZYME ACTIVITY.

The hydrogen-ion concentration of doughs is, among other things, important because of its effect on the enzymes of the flour and yeast. Enzymes are complicated compounds, present in living organisms, and capable, under ordinary conditions of temperature and moderate concentrations of acid or alkali, of bringing about many chemical reactions.

One of these enzymes is diastase, which is capable of converting the starch present in flour into a sugar. The reaction begins when, in making the dough, water is added to the flour and the whole is

* It is supposed that when certain substances (*e.g.*, acids, bases, and salts) are dissolved in water they split up completely in dilute solution, and to a less extent in more concentrated solution (as, for instance, in a dough mixture) into two kinds of particles with equal but opposite charges of electricity. These electrically charged particles are called "ions." To take some simple cases: Hydrochloric acid (HCl) in dilute solution in water breaks up into ions of hydrogen (H) which carry positive (+) charges, and an equal number of chlorine (Cl) ions carrying negative (—) charges of electricity. Common salt (NaCl) breaks up into positive sodium (Na) ions and negative chlorine (Cl) ions.

maintained at a suitable temperature. The yeast present in the dough contains other enzymes which convert this sugar, and also the sugar present in small quantities in the original flour, finally into carbon dioxide (CO_2) and alcohol. Most of the alcohol escapes, but the carbon dioxide is to a large extent retained in the dough, forming small bubbles in the gluten and making the dough rise and so assume the shape of the loaf. The evolution of adequate amounts of carbon dioxide, which is dependent on vigorous enzyme activity, is therefore essential for the efficient fermenting and proving of the dough.

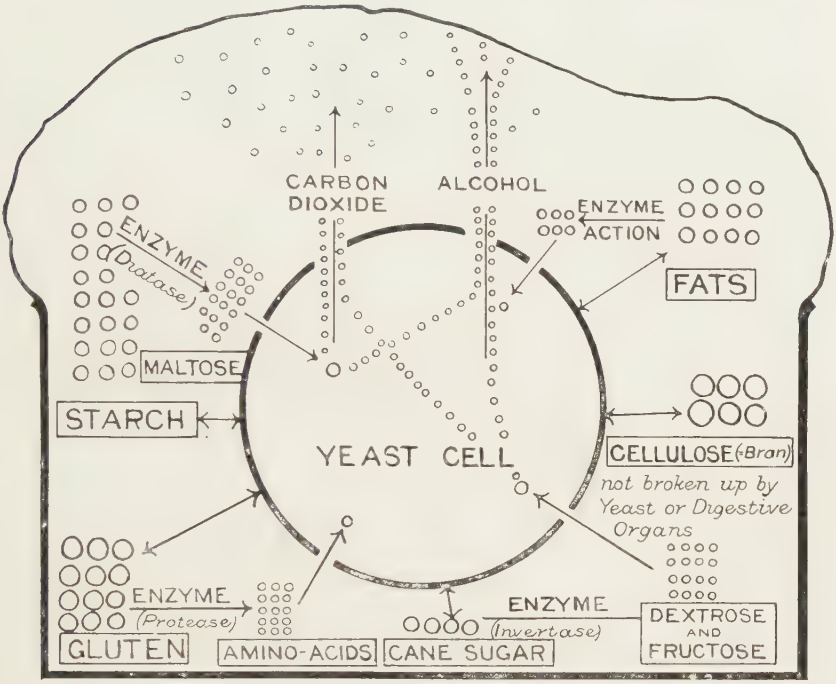


FIG. 10. DIAGRAMMATIC REPRESENTATION OF THE ACTIVITIES OF ENZYMES IN BREADMAKING.

The method by which the nutrition of the yeast cell is maintained, and the complex series of changes which take place, are indicated. Reversed arrows are intended to show that the yeast cell cannot act directly upon the molecules of these dough constituents, but that the latter must be first broken down by other enzymes into simpler molecules.

[Adapted from diagram in "Die Theorie der praktischen Brot und Mehlbereitung." A. Fornet.

There are said to be fourteen different enzymes in yeast, but only four are of any considerable importance—namely, invertase, maltase zymase, and protease. Flour contains (among others) diastase and protease. Malt-extracts which are sometimes added to flours contain a considerable amount of diastase, as well as a certain amount of protease.

Fig. 10, which is adapted from an ingenious drawing by Fornet (2), shows diagrammatically the changes which are brought about by

enzyme activity during breadmaking, and the means by which the all-important nutrition of the yeast cell is maintained.

PRODUCTION OF CARBON DIOXIDE.

For the production of a good loaf a sufficient volume of carbon dioxide must obviously be produced. This depends in turn upon the activity of the different enzymes present in the dough, for the more active they are the greater will be the production of gas necessary to make the dough rise. Two sets of conditions—though there may be others—favour maximum enzyme activity. One of these is temperature, and for this reason dough is kept moderately warm during proving; yeast is most reactive at 26·7° C., though a temperature of 32°–35° C. (90°–95° F.) is maintained in the bakehouse. The other condition necessary for maximum activity is a suitable concentration of hydrogen ions. For instance, the enzyme diastase present in malt preparations used for improving flour-strength is *twice* as active at pH 5·0 as at pH 6·0.

$_{p}$H OF FLOUR AND DOUGH AND DEGREE OF BUFFERING.*

Flour itself has a value of pH 6·0, more or less, but it has been found that for breadmaking the best concentration of hydrogen ions in the dough is about pH 5·0. Such an increase in active acidity occurs during fermentation; a flour of good baking-value approaches this value more nearly than a poorer flour. The conditions present in poor flours are such that perhaps they are not able to attain this optimum degree of active acidity at all, or, if they do attain it, only very slowly. These poorer flours are for some reason resistant to any change in active acidity—that is, from pH 6·0 to 5·0. The power of resistance to such change is known as the degree of "buffering" of the dough. The relative degree of buffering can be measured, and should give some idea of the ease with which the dough attains the hydrogen-ion concentration necessary for maximum enzyme activity and therefore for the production of a good loaf. In column 12 of Table 9 the relative degree of buffering of the flours examined in 1925 is given. It should be explained here that the higher the degree of buffering the *lower* will be the figure in column 12—that is, the less easily will any change in active acidity be brought about, or the less easily will such a flour attain the requisite pH for the best results in baking. Unless this is clearly realized the figures will only prove confusing. Average flours show a figure of 1·0–1·1; better flours show values from 1·2–1·4; poorer flours, values from 0·9 down to 0·5.

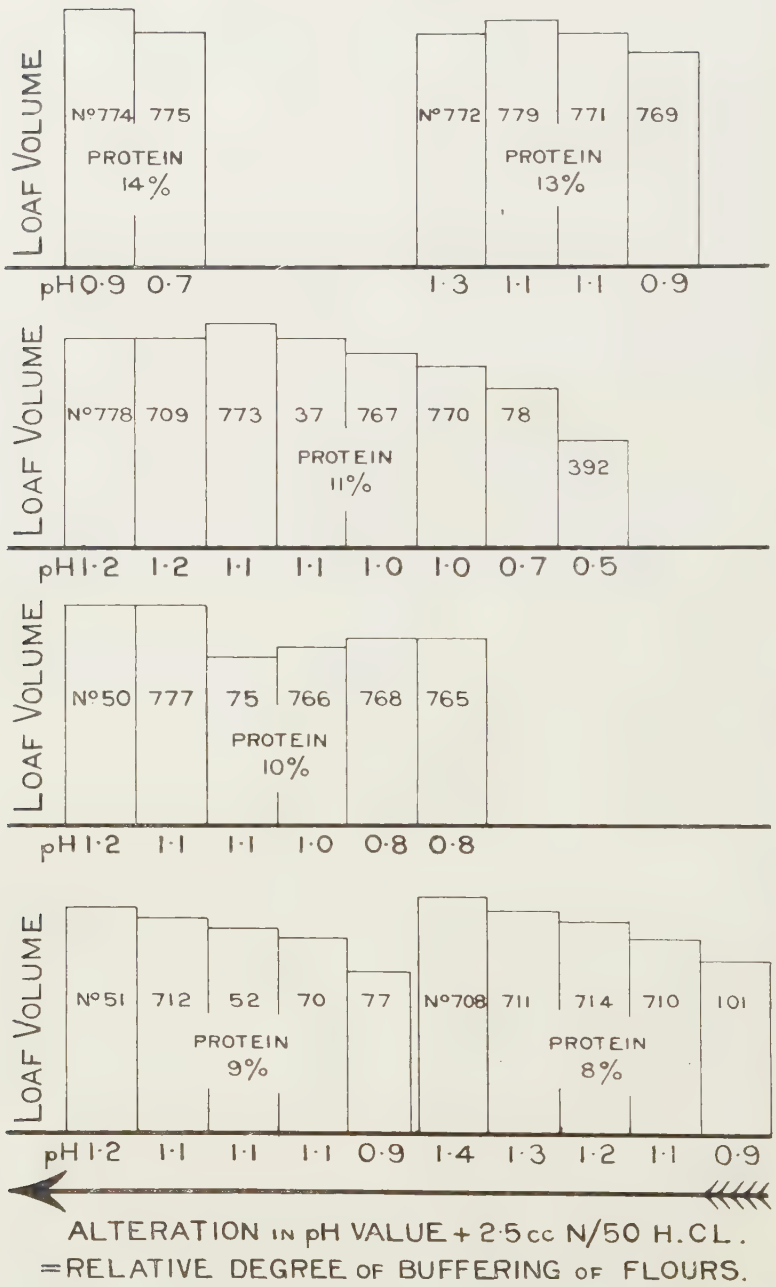
The method of determining the pH value of these flours was the colorimetric one. Forty grams of flour were mixed with 100 grams of distilled water and digested for one hour at 25° C. The suspension was filtered, as it was found that the filtered extract gave the same

* Buffer action: If one were to add a drop of hydrochloric acid to a quart of water the resulting solution would have a well-marked active acidity, as the hydrochloric acid would break up almost completely into hydrogen and chlorine ions. If, on the other hand, one were first to add certain substances (such as phosphates or proteins, both present in flour) to the water, and then to add the drop of hydrochloric acid, the resulting change in active acidity (pH) would be hardly appreciable. This action of certain substances (like phosphates and proteins) to resist any change in active acidity is called a "buffer" action.

Table 9.—Hydration Capacity, pH of Flour, and Degree of Buffering, &c.

1 Sample No.	2 Variety.	3 Locality.	4 County.	5 Approx. Protein Content.	6 Protein.	7 Loaf-volume.	8 Ratio, Wet to Dry Gluten.	9 Hydration Capacity.	10 pH Flour.	11 pH Flour + 2·5 c.c. N/50 Acid.	12 Relative Degree of Buffering.*
				Per Cent.	Per Cent.	C.C.		Per Cent.			
S 774	Essex Conqueror ..	Ashburton ..	Ashburton ..	14	14·60	755	3·26 : 1	39	6·0	5·1	0·9
S 775	Yeoman ..	,, ..	,, ..		14·19	700	3·20 : 1	53	5·9	5·2	0·7
S 772	Snowdrop ..	,, ..	,, ..		13·50	700	3·32 : 1	10	5·9	4·6	1·3
S 779	Scandinavian ..	,, ..	,, ..	13	13·75	720	3·25 : 1	14	5·9	4·8	1·1
S 771	Velvet	,, ..	,, ..		13·50	700	3·30 : 1	13	6·0	4·9	1·1
S 769	Marquis	,, ..	,, ..		13·75	660	3·08 : 1	75	5·9	5·0	0·9
S 778	Hybrid W ..	,, ..	,, ..		11·88	660	3·17 : 1	32	5·9	4·7	1·2
S 709	Tuscan	Arrowtown	Lake ..		11·75	660	2·94 : 1	12	5·8	4·6	1·2
S 773	Velvet Ngapara ..	Ashburton ..	Ashburton ..		11·88	670	3·12 : 1	76	5·9	4·8	1·1
T 37	Velvet	Lincoln ..	Springs ..	11	11·13	650	3·25 : 1	58	5·9	4·8	1·1
S 767	Queen Fair ..	Ashburton ..	Ashburton ..		11·31	640	3·28 : 1	43	6·0	5·0	1·0
S 776	Zealand	,, ..	,, ..		11·63	590	2·98 : 1	49	5·9	4·9	1·0
T 78	Durum	Hinds ..	,, ..		11·81	540	3·12 : 1	48	6·0	5·3	0·7
S 392	,, ...	..	..		11·81	440	2·80 : 1	26	5·9	5·4	0·5
T 50	Marquis	Gore ..	Southland ..		10·88	680	2·93 : 1	59	5·9	4·7	1·2
S 777	Red Fife ..	Ashburton ..	Ashburton ..		10·56	680	2·76 : 1	60	5·9	4·8	1·1
T 75	College Hunter's ..	,, ..	,, ..	10	10·31	560	3·07 : 1	55	5·9	4·8	1·1
S 766	Queen Fan ..	,, ..	,, ..		10·31	570	2·72 : 1	51	6·0	5·0	1·0
S 768	Major	,, ..	,, ..		10·75	600	3·28 : 1	39	5·9	5·1	0·8
S 765	Jumbuck ..	,, ..	,, ..		10·69	600	3·08 : 1	52	5·9	5·1	0·8
T 51	Major	Gore ..	Southland ..		9·63	680	3·13 : 1	50	6·0	4·8	1·2
S 712	Tuscan	Gibbston ..	Lake ..		9·38	660	2·86 : 1	40	5·9	4·8	1·1
T 52	Solid-straw Tuscan	Gore ..	Southland ..	9	9·44	640	3·20 : 1	55	5·9	4·8	1·1
T 76	Velvet	Ashburton ..	Ashburton ..		9·25	630	3·19 : 1	37	6·0	4·9	1·1
T 77	Solid-straw Tuscan	,, ..	,, ..		9·69	535	2·99 : 1	51	5·9	5·0	0·9
S 708	Tuscan	Gibbston ..	Lake ..		8·69	700	2·69 : 1	48	5·9	4·5	1·4
S 711	,, ...	Arrowtown	,, ..		8·56	670	2·89 : 1	60	5·9	4·6	1·3
S 714	Velvet	Ardgour ..	Vincent ..	8	7·19	650	2·76 : 1	53	5·9	4·7	1·2
S 710	Tuscan	Miller's Flat	Lake ..		8·50	620	2·96 : 1	44	6·0	4·9	1·1
T 101	Hybrid W ..	Horrelville	Eyre ..		8·75	580	3·04 : 1	39	5·9	5·0	0·9

* = Change in pH of 25 c.c. of flour suspension + 2·5 c.c. N/50 hydrochloric acid.


LOAF VOLUME
Nº774 775
PROTEIN 14%
Nº772 779 771 769
PROTEIN 13%
pH 0·9 0·7 1·3 1·1 1·1 0·9
LOAF VOLUME
Nº778 709 773 37 767 770 78 392
PROTEIN 11%
pH 1·2 1·2 1·1 1·1 1·0 1·0 0·7 0·5
LOAF VOLUME
Nº50 777 75 766 768 765
PROTEIN 10%
pH 1·2 1·1 1·1 1·0 0·8 0·8
LOAF VOLUME
Nº51 712 52 70 77 Nº708 711 714 710 101
PROTEIN 9%
PROTEIN 8%
pH 1·2 1·1 1·1 1·1 0·9 1·4 1·3 1·2 1·1 0·9
ALTERATION IN pH VALUE + 2·5 cc N/50 H.CL.
=RELATIVE DEGREE OF BUFFERING OF FLOURS.

GRAPH 4.

Showing the connection, in flours of approximately the same protein content, between the degree of buffering of the flours and the volumes of the loaves obtained from them. The less the flour is buffered, the greater is its tendency (among the samples investigated) to form a loaf of good volume. The arrow emphasizes the *increase* in loaf-volume with decrease in relative degree of buffering of flours.

value as a suspension cleared centrifugally. The pH value of the clear extract was taken as the pH of the flour. For ascertaining the relative degree of buffering of the flour, 25 c.c. portions of the clear extract were treated with 2·5 c.c. and 5·0 c.c. of N/50 hydrochloric acid ; these were then brought to a volume of 50·0 c.c. and their pH value determined. Only the figures obtained on the addition of 2·5 c.c. of acid are given in the table, as it was found that the order of change of the pH value was the same with 2·5 c.c. and 5·0 c.c. acid. The above method is practically that described by Rumsey (8).

In Table 9 the flours are arranged first of all in order of approximate protein content ; some such division is necessary to eliminate the effect on loaf-volume of other factors such as protein content (see column 6). The flours are thus divided into six series, containing respectively 14 per cent. protein, 13 per cent., and so on. Each series is then arranged in order of the degree of buffering (column 12) of the different flours. It will be seen that there is a close correlation in each series between the degree of buffering and the loaf-volume. This is shown more clearly in Graph 4, which illustrates diagrammatically this close relationship. In each series, with very few exceptions, there is a decided decrease in loaf-volume from left to right, coinciding with an increase in degree of buffering.

These buffer figures also explain the failure of certain flours with a good protein content to make good loaves. Especially so is this the case with samples of Durum ; S 392, which was very highly buffered, possessed very poor baking-qualities ; and S 78, which also showed a high buffer value, was only a little better (Fig 11). In addition, these figures throw light on the flours of low protein content which produced good loaves. For instance, the samples from Lake County (Fig 12) were without exception lightly buffered ; so were the samples from Gore (Fig. 13). These samples all gave better baking tests than their protein content indicated, as pointed out at the time in Part III (*Journal*, January, 1926). It will be noticed, too, that Lake and Southland varieties occupy prominent places in each series in Table 9—that is, in each series of flours containing about the same amount of protein.

In this series of tests the degree of buffering of the flours was undoubtedly closely connected with the volume of the loaf (column 7). A lightly buffered flour gave in general a loaf of good volume ; a highly buffered flour gave one of poor volume. This factor appeared more important than protein content among such flours. Where the degree of buffering of the flours was an average value the protein content was a fair indication of strength. In Part III it was also said that Marquis (S 769), amongst the Ashburton samples, was perhaps not so good as its protein figure indicated (Fig. 14) : this may be explained by its high degree of buffering. Scandinavian (S 779), Velvet (S 771), Snowdrop (S 772), and Red Fife (S 777) were described as better than would appear from their protein content (Fig. 14) : these varieties were all buffered to a less extent than average samples.

The results obtained as a whole thus indicate that flours more lightly buffered than average samples will produce loaves of good volume, even though they may be low in protein content. The reverse is also true : highly buffered flours, even though they possess a high protein content, will produce poorer loaves than such protein content suggests.

TRACINGS OF EXPERIMENTAL LOAVES.

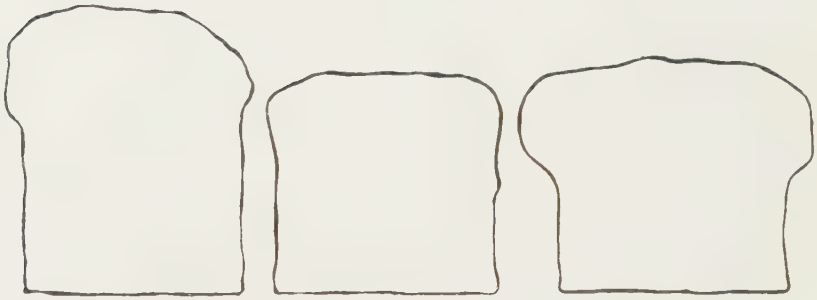


FIG. 11.

The two Durum wheat-flours failed to make good loaves; both were highly buffered samples. The check loaf was that one made from a sample of good average baker's flour and baked with each batch of loaves.

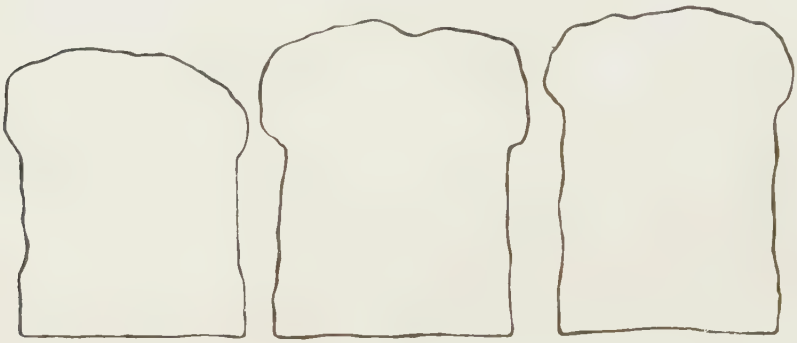


FIG. 12.

Samples S 768 and 711, both from Lake County, were low in protein content, but made loaves of very good volume. Both were lightly buffered.

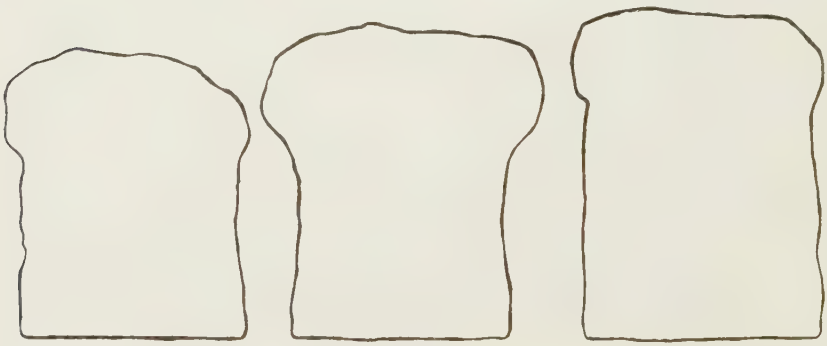


FIG. 13.

Showing the good volume of the two Southland samples. These were both lightly buffered.

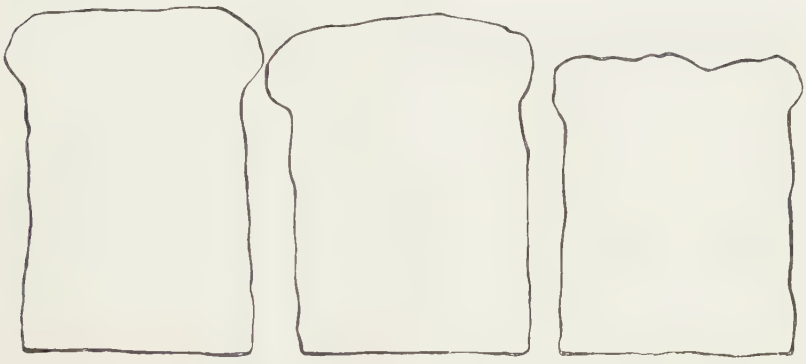


FIG. 14.

Baked from three Ashburton wheat-flours. These flours each contained approximately the same amount of protein, but Marquis (S 769), with the smallest loaf-volume, was the most highly buffered.

From theoretical considerations alone one would not expect the initial pH of the doughs of straight-grade flours such as these experimentally milled flours to have any close relationship with their baking-value, nor was any found in the flours investigated. The best criterion of baking-value, other things being equal, was the degree of buffering of the flour.

The percentages of ash are not given in the table, but only a slight correlation was found between ash, initial pH value of the flour, or degree of buffering. A slight but not very obvious correlation was found between degree of buffering and quality of flour as indicated by the hydration capacity of the moist gluten. No correlation could be found between percentage absorption of water and degree of buffering, or initial pH value of the flour.

SUMMARY.

(1.) The hydration capacity of the moist glutens of flours obtained in 1925 from thirty-two New-Zealand-grown varieties of wheats was not always an indication of the quality of the flours as revealed by baking tests. There was, however, a fairly close relationship between hydration capacity and texture of the loaves.

(2.) There was no relationship between quality of gluten as determined respectively by hydration capacity and by visual inspection of the gluten.

(3.) The initial pH of the flour was not connected with loaf-volume

(4.) The hydrogen-ion concentration of the dough in the later stages of fermentation must theoretically be of considerable importance. An idea of the relative ease with which optimum conditions of hydrogen-ion concentrations are attained in the dough should be gained from a determination of the degree of buffering of the flour. Among the flours examined it was found that in those of approximately the same protein content the degree of buffering was closely correlated with the loaf-volume. It was found, too, that a highly buffered flour, even though of high protein content, produced a loaf of poor volume; and,

conversely, a lightly buffered flour, even though low in protein content (see Lake County and Southland samples), produced a loaf of good volume.

REFERENCES.

(1.) Blish, M. J., and Sandstedt, R. M. Viscosity Studies with Nebraska Wheat Flours. *Cereal Chemistry*, 1925, p. 191.

(2.) Fornet, A. Die Theorie der Praktischen Brot und Mehlbereitung, 1923, p. 240.

(3.) Gortner, R. A., and Sharp, P. F. Physico-Chemical Properties of Strong and Weak Flours. *Journal of Physical Chemistry*, 1923, 27, pp. 481, 567, 674, 771, 982.

(4.) Gortner, R. A., and Doherty, E. M. Hydration Capacity of Gluten. *Journ. Agric. Research*, 1918, 13, p. 389.

(5.) Kent-Jones, D. W. Modern Cereal Chemistry, 1924, p. 93.

(6.) Luers, H., and Schwartz, M. Relation of Viscosity to Baking-quality. Abs. in *Journ. Soc. Chem. Industry*, 1925, 470 B.

(7.) Luers, H., and Ostwald, W. Colloid Chemistry of Bread. Abs. in *Journ. Soc. Chem. Industry*, 1920, 499 A.

(8.) Rumsey, L. A. Diastatic Enzymes of Wheat Flour. Am. Institute of Baking, Bull. 8, 1922, p. 57.

WEEDS AND THEIR IDENTIFICATION.

(Continued.)

BATHURST BURR (*XANTHIUM SPINOSUM* L.).

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Bathurst burr has been a wild plant for a great many years in New Zealand; it was first recorded in 1864 as naturalized in the North, and appeared as far south as Wellington in 1877. Later it showed signs of spreading freely, particularly on the North Island east coast,* and from 1890 onwards there was a good deal of controversy on the question as to whether it was likely to prove as serious a menace as in Australia. The outcome of this was that the plant was included under the Noxious Weeds Act, 1900, in the schedule comprising those plants deemed to be noxious weeds when so declared by a local authority. Although it is definitely not a weed of the first rank in New Zealand, its Australian reputation means that we cannot afford to ignore it altogether. As, moreover, Bathurst burr is often confused with other quite different plants, it has been thought well to include it in this series of articles.

DESCRIPTION.

Bathurst burr (which is sometimes placed by botanists in the daisy and thistle family, and sometimes in a small, closely allied one) is an annual, 1 ft. to 3 ft. high, and bushy in habit owing to its freely branching stems. The stems are rather wiry, and are covered, particularly

* For further details see "The Naturalization of Animals and Plants in New Zealand," by G. M. Thomson.

in their upper and younger parts, with short hairs, which give them a greyish-white colour. The leaves are arranged first on one side of the stem and then on the other ("alternate"), 1 in. to 4 in. long, tapering more or less gradually at both ends, and those at the tops of the branches are roughly lance-shaped in outline, with a few small teeth or with none at all. Farther down on the stems this shape is lost sight of through the leaves being deeply and irregularly lobed—three-lobed in reality, with the middle one much the biggest, and often with a number of secondary ones as well. The upper surface of the leaf is green, but the midrib and veins above, and all *except* the midrib and veins below, are clothed in a greyish-white covering of hairs like that on the stems, only thicker. The leaves on the upper parts of the stems are almost stalkless, while the larger ones lower

FIG. 1. BATHURST BURR, PHOTOGRAPHED NEAR WAIROA, HAWKE'S BAY.
[*Photo by W. D. Reid.*

down taper at their bases to stalks that may be as much as 1 in. in length. From the junction of leaf and stem ("axil") springs a very conspicuous three-pronged yellow spine—the middle prong longer than the others. Often these spines are in pairs at the axils. It is their presence that gives the plant its specific name *spinosum*, and makes it easy to identify at almost any stage in its life-history.

The flowers are in heads of two sorts, the male and female ones being borne separately. In the drawing (Fig. 2) two clusters of male flowers can be seen at the top of the branch, and no further description of these will be given, as they are not of much assistance in identifying the weed. The female head or "burr" is hard and bony in texture, about ½ in. long, cylindrical in shape, tapering to its connection with

FIG. 2. BATHURST BURR.

(*a*) Branch with burrs, natural size; (*b*) burr, showing hooked spines, magnified about three diameters.

[*Drawing by E. H. Atkinson.*

the branch at one end and to one or two short beaks at the other. It is pale yellow in colour, hairy on the surface, and is covered with dark-coloured spines tipped with yellow hooks. If a burr is cut across it will be found to contain two cells, each filled with an achene (so-called seed). These remain within the burr until it decays, and do not possess anything corresponding to the down of thistles.

DISTRIBUTION AND CONTROL.

Bathurst burr is a native of South America, but now occurs as an introduced plant in most warm countries. In New Zealand it is found chiefly in the warmer soils of the North Island, and is most abundant in Hawke's Bay. It has been reported as "rare" in Marlborough—the only South Island locality that the writer is aware of. It is often said of the plant that it is sporadic in its occurrence—that is, single individuals may be found scattered in widely separated localities. It would certainly be advisable to destroy any such plants that may be found. The bony character of the burrs is a fact already mentioned, and it may be repeated here, since it means that fruits may lie for a long time in the ground before their decay allows germination to take place, and might help to account for certain irregularities of occurrence of the plant.

Bathurst burr is not a serious weed of pasture, and cannot maintain itself where there is a good sole of grass. Experiments indicate that at certain stages the plants are poisonous to stock, which may also suffer mechanical injuries from the spines, but as a rule it is avoided by them. The real danger in allowing it to spread lies, of course, in the very great damage the burrs may do to wool. Enough evidence on this point is available from Australia to convince the most sceptical. As was pointed out in the leaflet on Bathurst burr issued many years ago (1900) by this Department, all efforts to stop the spread of a plant which depends for its distribution on the entangling of its very numerous hooked burrs in wool should be directed towards the prevention of the formation of such burrs, and the weed should be attacked in the flowering stages. In the *Monthly Bulletin of the Department of Agriculture, State of California*, spraying with a solution of copper sulphate (1 lb. to 10 gallons of water) is recommended as effective against young plants 6 in. to 1 ft. high.

The average cow requires 10 tons of grass or its equivalent to maintain itself during the year. Maintenance requirements being satisfied, every extra ton of grass consumed is capable of producing some 30 lb. of butterfat. Feed to the maximum capacity so as to increase the amount available for production.

Rushes and sedges are plants indicating stagnant water in the soil. This defect must be removed to secure high productivity in pastures or annually sown crops. Drainage, therefore, is the first improvement necessary on waterlogged soils.

Suitable soil, plenty of lime, presence of nodule bacteria, freedom from weeds, avoidance of continuous grazing, are the main factors concerned in successful lucerne-growing.

INSECT GROUPS ASSOCIATED WITH FORESTRY.

Extract from State Forest Service Bulletin No. 2, "Forest and Timber Insects in New Zealand," by DAVID MILLER, B.Sc., F.E.S., Entomologist, Department of Agriculture.

BEFORE dealing with the insect groups associated with forestry, the following brief account of insect characteristics will no doubt be of assistance to the better understanding of what is to follow.

Although insects are built upon characteristic lines, they exhibit a vast variation of the fundamental plan and habit. Many adult forms are winged, and others wingless. In the former there are typically two pairs of membranous wings attached, with the three pairs of legs, to the thorax or middle part of the body (Fig. 19). The abdomen or hind part of the body of the adult has no appendages of locomotion, but in the female of many species there is attached an appendage—the ovipositor—by means of which the eggs are placed in suitable position. From the egg—in the case of a moth or beetle, for example—a young grub or larva hatches and commences to feed, growing at the same time and moulting its skin more or less frequently until it is fully developed, when it transforms to an inactive pupa or resting stage, in which the final touches in the transformation from larva to adult take place. When this transformation is complete the pupa splits open and the fully grown insect emerges. In the case of many other insects, however, such as the eucalyptus psyllid (Fig. 75), or an aphid, the larva is not a grub, but resembles the adult in general form. As this young insect grows (Fig. 75 *c*) it sheds its skin, as the latter becomes too small, and grows a larger one. This moulting goes on, and the rudiments of the wings appear as small outgrowths on each side of the thorax (Fig. 75 *b*). By further moults there is a gradual transformation to the adult. There are, then, two general methods of insect-development: one, as in the moth or beetle, where there are four distinct stages each with a form and habits of its own—*i.e.*, egg, larva, pupa, adult; and the other where the young resemble the adult in all but size and mature characteristics.

The method of feeding varies also. In the case of adult beetles, and the larvæ of beetles and moths, &c., the head is armed with jaws enabling the insect to eat foliage or bore its way through the tissues of plants. In a scale insect, aphid, &c., the mouth-parts are modified as a delicate piercing structure, which is inserted into plant-tissues and the nutrient juices, or sap, sucked up.

BEETLES.

Beetles are readily distinguished by the hardened forewings forming a pair of covers or cases (elytra) which close over the body, only the fore part of the thorax remaining exposed, and beneath which the membranous hindwings are folded (Fig. 20). The following are the families of particular interest to the forester, although the characters given are not altogether typical for each family as a whole, but of such species as are of direct interest.

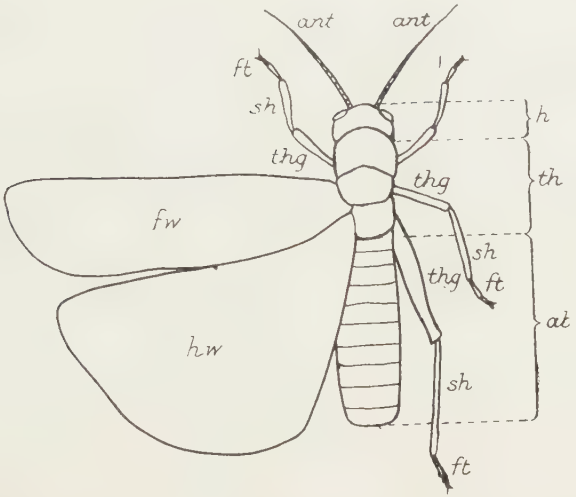

FIG. 19. DIAGRAM OF AN INSECT, SHOWING PRINCIPAL PARTS.

Ant, antennæ; *h*, head; *th*, thorax; *ab*, abdomen; *thg*, thigh; *sh*, shank; *ft*, foot; *fw*, forewing; *hw*, hindwing.

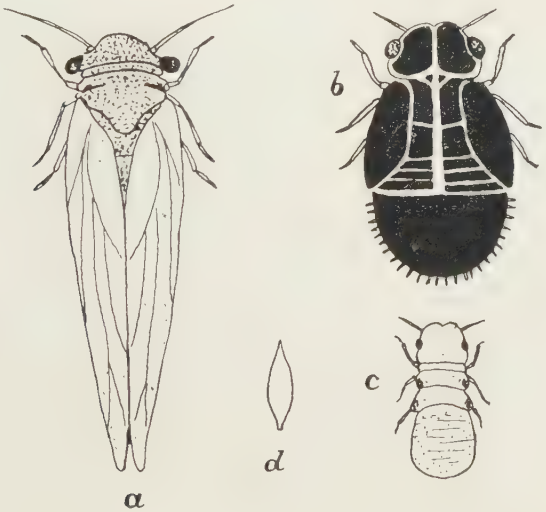

FIG. 75. EUCALYPTUS PSYLLID.

a, Adult; *b*, nymph; *c*, larva; *d*, egg. × 20.

The flat-headed borers (Buprestidae) are so called on account of the characteristic shape of many of the larvæ, which are legless or possess very rudimentary legs, and have the front segments of the body, behind a small head, greatly broadened and flattened, the remainder of the body being comparatively narrow and tail-like. The larvæ of certain buprestids which feed upon foliage are not of the flat-headed type, but are rather cylindrical in form, the body tapering from in front backwards. Some species are very destructive and bore shallow mines, as wide as the broadened part of the body, between the bark and sap of living trees, which are thus exposed to the depredations of other insects and eventually killed. The heart-wood may also be attacked by some buprestids. On the upper and lower side of the broadened end of the body is a thin flake-like plate, and a feature by which the larvæ of this family can be characterized is the inverted V-shaped groove on the upper plate. When the larvæ is fully developed it works its way to the bark, where it excavates a cell, just beneath the surface, in which the pupa lies. On the adult emerging it gnaws its way through the thin covering of bark to the open air. After mating, the female lays her eggs in wounds on the bark or in crevices, and the larvæ on hatching therefrom work their way into the tree, their tunnels widening as the larvæ grow in size.

This family is a very large one in the tropics, but is not extensively represented among the New Zealand beetles. There is one species said to be introduced

The death-watch beetles (Ptinidae) form a group embracing the well-known and destructive so-called white-pine or common house-borer (*Anobium domesticum*), which infests dried timber. The beetles are very small, and may be recognized by the head bent downwards and covered from above by the front part of the thorax. The female lays her eggs in seasoned wood, particularly sap, and the larvæ burrow through in all directions, reducing the infested parts to a honeycombed mass, leaving nothing but an outer shell of wood. The pupæ transform within the burrows, and the adults on emerging cut a neat circular hole through the surface of the wood. Badly infested timber is punctured by innumerable holes, which the adults frequently re-enter to lay their eggs. The larvæ are small, whitish in colour, and soft-bodied and plump; they lie in a characteristic doubled-up position within the wood, and their presence may be frequently detected by the quantities of fine wood-dust ejected through old openings on the surface. The most outstanding representative of this family in New Zealand is the cosmopolitan house-borer, but there are several native species, some of which will no doubt prove to be destructive.

The powder-post beetles (Bostrychidae): Some of the species belonging to this family are amongst the most destructive, attacking living or dead timbers and finished products. The larvæ resemble in size and shape those of the Ptinidae. The species herein recorded are rather elongate and narrow, but there are others more robust in the adult stage. The beetles themselves burrow into the wood, and occur in the burrows inhabited by their larvæ. The powdered wood is not the fine dust as ejected by the ptinids, but consists of finely shredded particles. *Lyctus brunneus* is an example.

FIG. 20. HUHU BEETLE WITH WINGS EXPANDED,

Showing the hardened forewings, which form the wing-cases (elytra), and the membranous hindwings.

[*Photo by E. B. Levy.*

FIG. 107. WOOD ATTACKED BY HUHU LARVÆ. (NATURAL SIZE.)

The long-horned beetles (Cerambycidae) comprise a very large family of wood-borers, and there are a great many native species in the Dominion. The beetles themselves are readily recognized by their very long antennæ, in some species longer than the body, which is more or less elongate, often narrow, usually cylindrical, but sometimes rather flattened along the part covered by the wing-cases. Some are amongst our largest insects, while others are comparatively small. A number of them are powerful fliers, and emit a loud droning when on the wing, being frequently attracted to lights at night; others, again, are more or less sluggish, and remain motionless even when roughly disturbed. Several species when at rest create a distinct but faint squeak much like that made by an indiarubber "squeaking-doll." The stridulating-organ of these beetles is situated on the back, and consists of a triangular process projecting forward under the front part of the thorax from the middle of the body where the wing-cases are attached; the inner surface of the front part of the thorax is drawn over the point of this process and creates the characteristic squeak. Other species create a rasping sound by rubbing the hind thigh against the edges of the wing-cases. The larvæ have a small head and a fleshy cylindrical body, with the segments distinctly separated from each other. The front end is broadened, and tapers somewhat to the hind end, and in consequence the larvæ of this family are known as "round-headed borers" in distinction to the "flat-headed" buprestid type. While some of the cerambycid larvæ possess three pairs of very small legs, there are others which are quite legless and might readily be confused with some species of the buprestids; such are distinguished, however, by the absence of a V-shaped suture on the dorsal plate at the front end of the body of the cerambycid, and by the plate on the lower side being but imperfectly developed. A common cerambycid is the "huhu" beetle (Fig. 20).

The leaf-beetles (Chrysomelidae) are well represented among our native insects. The larvæ and adults of this family for the most part feed upon foliage. The larvæ are plump, and some of them are prominently coloured; some transform to pupæ on the leaves of their food plant, while others burrow into the ground for this purpose. The adults are usually oval in outline, with a strongly arched back; the antennæ are slender, but not usually long; the eggs are laid on foliage. The eucalyptus tortoise-beetle is an example.

The lamellicorn beetles (Scarabaeidae) differ greatly in the habits of the various species, of which there are a great many occurring in New Zealand. It is the group known as cockchafers with which the forester has to deal, since their larvæ are injurious to the roots of trees, particularly in nursery beds, and the adults to the foliage. The larvæ are readily recognized; they are white or cream-coloured, and live in the soil, lying doubled up in a characteristic attitude, the common "grass-grub" being a typical form. The beetle is stout in form, and the wing-cases do not cover the end of the abdomen, which protrudes much as if the wing-cases were a size too small for the beetle. The head is broad and blunt in front, and the short antennæ have the terminal joints produced on one side much like the fingers of a hand—hence the name "lamellicorn." The front legs are adapted for burrowing in the ground, the shanks being flattened and acting as shovels. Several species are nocturnal as adults, and when large

flights occur may cause considerable damage by defoliating trees. The eggs are laid in the ground, and the life-cycle of many of the New Zealand species takes a year to complete.

Weevils (Rhynchophora). This group of beetles is a very extensive and most important one from an economic standpoint, a great many species being prominent as borers in live and dead timbers; the larvæ are legless. There are four families, three of which are dealt with here. The typical weevils are easily recognized by the long trunk-like prolongation of the head, at the end of which the mouth and jaws are situated, but there are others which have not this character so prominently developed. The first family is the Brenthidae, represented in New Zealand by at least two species, commonly known

FIG. 89. THE EUCALYPTUS LEAF-WEEVIL: ADULT ATTACKING FOLIAGE. × 6.

[*Photo by E. B. Levy.*

as "giraffe-beetles" on account of the extremely long auger-like snout or beak by means of which the female bores a hole in dead wood in order to lay her eggs. The long-bodied cylindrical beetles vary considerably in size, and, contrary to the usual rule, the male is smaller than the female. The male has the antennæ situated at the tip of the snout, but on the female they are attached towards the middle. The larvæ bore through the wood and transform to pupæ in the burrows. The pupæ are easily recognized by the long snout doubled under the body with the legs.

The second family is the Curculionidae, or the typical weevils, and embraces most of the Rhynchophora; they all possess a distinctly developed snout (Fig. 89). The members of this family have a wide range in their depredations upon plant-life, both the adults and larvæ

frequently being responsible for considerable destruction. They are borers in the bark and wood of living and dead timbers, or they feed upon the foliage, roots, or fruit. In the case of borers the eggs are placed by the female within the tissues of the plant, her snout being used to construct a cavity for their reception; the eggs of leaf-feeders are laid upon the foliage of the food plant.

The larvæ are plump and legless grubs, the front end being thicker than the posterior, and the body usually lies in a slightly curved position. By means of the strong jaws they are able to eat their way through woody tissues. The pupæ of the wood-borers transform in the burrows, but the larvæ living upon foliage may enter the ground to transform. The adults have a characteristic knack of abruptly dropping off a tree if alarmed, and lying perfectly motionless on the ground with the legs curled up close to the body. Many of the arboreal species when handled cling tenaciously to one's hand by means of a dense brush-like pad on the lower surface of the feet.

The Scolytid weevils (Scolytidae) comprise the third family, and many of them are most destructive to living, dead, or dying timbers. They are small beetles, the body being elongate and narrow or short and stout. They differ from most other weevils in the absence of a distinct snout. The short antennæ are elbowed, and each ends in a knob. The entrance to the burrows of the adults is marked by the quantities of finely shredded wood which accumulate at the orifice, and is very conspicuous upon the bark. The main burrow is constructed by the parent, and the eggs are laid therein, each small legless fleshy larva boring a burrow for itself off the parent tunnel.

MOTHS.

Moths are so well known as such that a lengthy description is hardly necessary; they possess two pairs of wings, which are usually clothed with a powdery dust formed by innumerable minute scales; they usually subsist on the secretion of flowers, &c., and the mouth-parts are in the form of a long sucking-tube, which is carried coiled like a watch-spring beneath the head when not in use. The moths themselves are not destructive; it is their larvæ or caterpillars (Fig. 94) with which we have to contend. The latter are worm-like in shape, with a distinct head, and the mouth-parts, unlike those of the adult, consist of strong jaws and their accessory parts by means of which they devour foliage, fruits, seeds, or even bore through the woody parts of plants. The three segments behind the head correspond to the thorax, and on the under-side of each is a pair of short legs. There are no legs on the abdominal segments, but there may be from one to four pairs of abdominal sucker-like "pro-legs," as well as a pair on the last segment at the end of the body.

Two groups of outstanding importance are the tortricids (Tortricidae) and tineids (Tineidae). The moths of the former are small species of sombre colour, and when at rest the wings form a roof-like ridge over the body. The front wings are more or less blunt at the end. The caterpillars are small, and a great many of them are leaf-rollers, feeding upon and sheltering within the rolled leaves. Examples of such species are the elusive tortrix and the oblique tortrix. The tineid moths are much smaller insects, in many cases with the narrow,

more or less pointed wings, fringed with delicate hair. Some of the smallest moths belong to this group, their caterpillars mining in the tissues of the leaves. Other species tie leaves together (*Proteodes carnifex*) or cut off a piece of leaf and web it down as a covering to the surface. Some are gregarious (the gregarious tineid), while others feed exposed on leaves or attack fruits and seeds.

FIG. 94 FULL-GROWN LARVA OF GHOST MOTH. (ABOUT NATURAL SIZE.)

[*Photo by E. B. Levy.*

There are two groups of larger moths, the caterpillars of which are foliage-feeders for the most part. In one group (Geometridae) there is only a single pair of abdominal pro-legs on the caterpillars, which progress by a looping movement during locomotion. In the other group (Noctuidae) the caterpillars possess two or four pairs of abdominal pro-legs.

SAW-FLIES.

The saw-flies (Tenthredinoidea) are four-winged insects, and belong to the same group as the bees and wasps, from which they may be recognized by the fact that the abdomen is not restricted in the form of a waist where it joins the body, as is the case with bees, &c. By means of the stout ovipositor the female saws a cavity—hence the name "saw-fly"—through the bark or beneath the epidermis of the leaf, according to the species, and in the cavity so formed deposits an egg. The grub, on hatching, commences its attack upon the plant. The grubs of the species which deposit their eggs beneath the bark are borers, and pupate within the burrows (steel-blue saw-fly), but those hatching from the eggs on the leaves emerge and feed exposed upon the foliage, and when fully grown enter the soil to pupate (the well-known pear and cherry slug, *Eriocampoides limacina*, for example).

SCALE INSECTS.

These insects (Coccidae) are widespread in their depredations, causing an enormous amount of damage to living plants. They feed upon the nutrient juices, which they reach by puncturing the plant-tissues by means of their delicate proboscis, and when they are present in large numbers weaken the plant to such an extent that the death of the latter frequently results.

Of the various forms of insects injurious to vegetation the scale insects, as a family, are undoubtedly of major importance, since they feed not merely upon one group, or allied groups, of plants, as do so many other injurious insects, but an extensive range of widely different plants are subject to their depredation.

Scale insects are extremely abundant in most parts of New Zealand. The individual insects are usually small and inconspicuous, but, owing to the fact that they lead a stationary or semi-stationary existence, they readily form conspicuous incrusted or flocculent colonies upon infested plants, into the tissues of which, whether bark, leaf, or fruit, the female drives her thread-like beak or proboscis and feeds upon the juices of the plant. Although the amount of nutrient plant-fluid absorbed by a single scale insect, or even by a few, is infinitesimal, the loss to the plant when heavily infested is so great that the vitality is weakened and productivity reduced, in many cases death of the host eventually ensuing.

Frequently these insects exude a sticky product known as "honey-dew," which is so abundant at times as to form a coating upon the leaves, stems, and fruit, and hinders respiration to a great extent. Further, this honey-dew acts as an excellent medium for the growth of a sooty mould, which, forming a black film, gives an unsightly and fire-scorched appearance to the plant.

Generally speaking, there are two groups into which all the scale insects may be placed, and the life-cycle of each differs somewhat. One group is spoken of as the *covered scales*, since the insect lives beneath a scale-like covering separate from the body. Examples of such forms are the white rata-scale and the greedy scale. The other group is the *naked scales*, or forms which have no scale-like covering, but are in some cases protected by a toughening of the skin as the karaka-scale, or lie within a felted sac as in the gum-tree scale, or are covered merely by a powdery secretion as the various species of mealy bugs, or the cottony cushion scale.

The female of a covered scale deposits a large number of eggs beneath the protecting scale, which may be filled more or less completely, the parent insect shrinking in size and eventually dying as the total number of eggs is produced. In some cases the eggs hatch before they are extruded, so that the female gives birth to living young. The eggs first deposited are usually the first to hatch, so that the young larvæ do not emerge all at once, but over a longer or shorter period according to climatic conditions and species of scale. The minute young larvæ on emerging from beneath the parent covering possess six legs, and are very active, moving about over the infested plant in search of a favourable spot, into which they insert the delicate thread-like proboscis and commence to feed on the plant-juices. The young females remain attached to the one spot for the remainder of their existence, losing their legs before reaching maturity, and, after taking up this position, commence to form the first waxy covering which will become part of the fully developed protecting scale. To this first covering is attached a second one, and to the second a third, the three forming the completed scale covering.

The life-history of the male differs from that of the female. The male retains his legs and passes through a pupal or resting stage

before emerging as a minute two-winged insect with no mouth-parts.

The naked scales differ from the covered scales in the retention of the legs by the female throughout life, so that the insects are capable of moving from one place to another. In such species as the gum-tree scale the body is protected by a felted sac, within which the young are produced. On the other hand, such insects as the cottony cushion scale form a fluted fibrous sac attached to the body, in which the eggs are placed. The mealy bugs are covered with a powdery secretion, and the eggs are laid in a specially constructed woolly sac, in the strands of which they are entangled. As in the first group, the males are two-winged insects. In all scale insects the females are wingless and incapable of flight.

APHIDS.

The aphids (Aphidae), or plant-lice, attack plants in the same way as scale insects, and although as a rule they are not protected by any covering (Fig. 29) there are many forms, such as the pine-chermes and the woolly aphis of the apple, which protect themselves by a woolly

FIG. 29. GREEN SPRUCE-APHIS ON SPRUCE-NEEDLE.

Showing insect with its proboscis inserted in tissues.

[*Photo by E. B. Levy.*

secretion. During its development an aphis passes through various stages. If a colony be examined, winged and wingless individuals may be found. The wingless ones may be females only, and give birth (parthenogenetically) to living young resembling the mother in general form but being much smaller; these grow rapidly in size until mature, when the business of reproduction goes on. At certain times of the year some of these wingless forms develop into winged females and males. Many of these females deposit eggs from which the wingless parthenogenetic forms hatch. On the other hand, some winged females are parthenogenetic and reproduce living wingless forms.

GALL INSECTS.

Malformation of plant-tissues is frequently brought about through the agency of insects, many having a very injurious effect upon the development of the infested plants. These malformations are known as *galls*, and assume various forms upon the bark, roots, or leaves of plants. Some galls form pimples on the leaf-surfaces, or completely

curl up the whole leaf; some form nodules on the foliage or bark and roots, while others take the form of sacs, &c. Within the galls the insects or their grubs live. Some of the commonest gall-forming insects are the chalcid wasps, which belong to the same group as the saw-flies, bees, and ants. They lay their eggs within the tissues of the plant, and the grubs, on hatching, set up a local irritation of the tissues, causing the malformation. Another group of insects is the two-winged midges (Cecidomyiidae), the grubs of which affect plants in the same way as the chalcid wasps. Some scale insects, aphids, and even moths are gall-makers. Several species of mites also attack plants in this way, causing extensive damage.

BENEFICIAL INSECTS.

In a free state of nature no insect is injurious. The many forms feeding upon vegetation (phytophagous insects) are an important factor governing the abnormal increase of plant-life. Such insects are in turn held in check by other species preying upon them (the insect-feeding or entomophagous insects), and are consequently prevented from causing extensive destruction to vegetation. Each species, therefore, has its own particular use in the preservation of the natural equilibrium. However, when any of nature's products become of value to man, and the insects subsisting on such products hinder the standard of development required by man being attained, it is then that the insects in question become injurious. The phytophagous and entomophagous insects thus differ in their economic application; the natural utility of the former may become detrimental, while that of the latter remains constant, and may be utilized and even increased.

The entomophagous insects, according to their habits, are of two kinds—predators which seek out and capture their victims, and parasites which live upon or within their host insects. Such beneficial insects comprise a very extensive and varied group. A great many of them feed on no particular species of insect, and their utility from an economic standpoint is therefore of less value than those which specialize in their victims. The following general outline deals with the latter forms.

Among the predaceous species the larvæ of certain hover-flies (Syrphidae) are outstanding. These larvæ are rather slimy, legless, and blind, but can nevertheless move rapidly about a plant in search of scale insects, plant-lice, and even caterpillars, the body contents of which they suck dry. Two of the commonest species of hover-fly met with in New Zealand are the New Zealand syrphus and the banded melanostoma; they are recognized by their hovering flight, remaining motionless in the air before suddenly darting off to hover again a short distance from, or even at, the starting-point. The New Zealand syrphus measures about $\frac{2}{5}$ in. in length, and is of a blue-black colour, with four pairs of narrow orange-red or cream-coloured spots on the abdomen. The banded melanostoma is somewhat shorter, and on the black abdomen of the female are four pairs of dark-yellow spots. The abdomen of the male is almost altogether yellow owing to the spots being very large.

Most of the ladybird beetles (Coccinellidae), both in the adult and larval stage, are also important predaceous enemies of scale insects

and aphids. The beetles are small insects, and readily recognized by their oval and dome-shaped outline; in colour they are blue or black, frequently with red, yellow, or white spots. The larvæ are also characteristic; they have three pairs of well-developed legs, and the body is frequently clothed with spine-like hairs; they are sombre-coloured or pictured with red or yellow spots.

A very common predator frequently found associated with hover-fly larvæ and preying upon the same insects as ladybirds is the larva of the Tasmanian hemerobid. This larva is alligator-like, and possesses a pair of caliper-like jaws which are adapted for sucking up the body contents of the captured insects. The pupa is very often found in a small, silken, loosely spun cocoon attached to grass, &c. The adult insect is small and greyish, and carries the seemingly too large net-veined wings closed roof-like over the body.

The parasitic insects are represented by a host of species the larvæ of which, for the most part, live upon or within the bodies of other insects, more particularly during pre-adult development of the latter. A very great many of them are of incalculable value, especially those which confine their attention to one species, or group of allied species, of insects. The principal groups of parasites are the tachina-flies (Tachinidae) and the ichneumon and chalcid wasps. The tachina-flies comprise a very large family of two-winged insects, and there are a great many species native to New Zealand. They are bristly flies for the most part, and vary greatly in size, some being very small and others as large as a humble-bee; they are usually of sombre colour, and many closely resemble blue-bottles in size and appearance, but differ in having the abdomen very bristly, and in the large bristle of the antennæ being destitute of hair. A great many different kinds of insects are attacked by tachinid larvæ, but most of their activities are confined to the caterpillars of moths. That an enormous proportion of insects are destroyed by these larvæ is evidenced by the abundance of the adult flies.

The ichneumon and chalcid wasps are probably more abundant than the tachinids. They usually possess two pairs of wings, but some are wingless; they are slender insects, and vary greatly in length, some being large and others almost microscopic; the colour is black, red, golden, or yellow, and many species are spotted or banded. They belong to the same order as the bees and wasps, and may be recognized by their rather waspish appearance, the abdomen being attached to the body by a more or less conspicuous stalk. Many species have a longer or shorter thread-like "tail"—the ovipositor—by means of which the host insect is punctured and the eggs laid within. Though the larvæ of many species live within the body of the victim there are others that are external parasites.

NOTE.—Most of the figure-number references to illustrations, and all page references to related parts of the bulletin, have been omitted from the foregoing extract. If is not feasible to reprint here more than a few of the large number of relevant illustrations included in the bulletin.

The Dorset Horn breed of sheep is reported to be coming rapidly into favour in Australia as fat-lamb producers.

DESTRUCTION OF TALL COUCH.

EXPERIMENT IN MARLBOROUGH.

F. W. GREENWOOD, B.A., Instructor in Agriculture, Blenheim.

A SUCCESSFUL and instructive experiment in the destruction of tall couch (*Agropyron repens*) has recently been completed on the property of Mr. R. F. Goulter, Riverlea, Blenheim. The 40-acre block in question was very badly infested with this troublesome weed. In the 1923–24 season the crop grown was Algerian oats. Acting on the writer's advice Mr. Goulter decided to substitute the method of smother cropping for the more expensive, and in this case more unsatisfactory, method of summer fallowing and cultivation.

Accordingly the stubble, soon after the oat crop had been harvested, was ploughed to a depth of 4 in. and then worked down with the cultivator and harrows. In March, 1924, Algerian oats and Scotch

FIG. 1. THE 22-ACRE BLOCK IN FIELD SOWN WITH OATS AND TARES ON MR. GOULTER'S FARM.

This area was grazed almost continuously and has reverted to tall couch.

tares were sown at the rate of 2 bushels of oats and 1 bushel of tares per acre. During the succeeding winter this crop was grazed off-and-on with 400 ewes, a grass-paddock adjacent to the oat and tare field being employed as a run-off. In the following spring Mr. Goulter continued to graze 22 acres of the oat and tare crop. At the end of February, 1925, every lamb was sent away fat. This particular block, as will be seen from Fig. 1, has now run right back to couch. Of the remaining 18 acres, 12 acres were cut for hay early in November, 1924, but a block of 6 acres right in the centre of the field was left uncut, the tares being allowed to run to seed. The seed was harvested in February, 1925, yielding 33 bushels per acre, and was sold at 8s. per bushel.

On the 12-acre block which was cut for hay the couch has greatly decreased in quantity, but has not entirely disappeared (see Fig. 2.) On the block from which the seed crop was taken, however,

the couch has practically disappeared, the only plant now growing being the relatively harmless weed scarlet pimpernel, as seen in Fig. 3.

One of the most noteworthy features about this experiment is that with many farmers it is the practice to summer-fallow for a full season before sowing a smother crop. In Mr. Goulter's case the seeding of the tares has effected the desired result. The economy of this method is obvious.

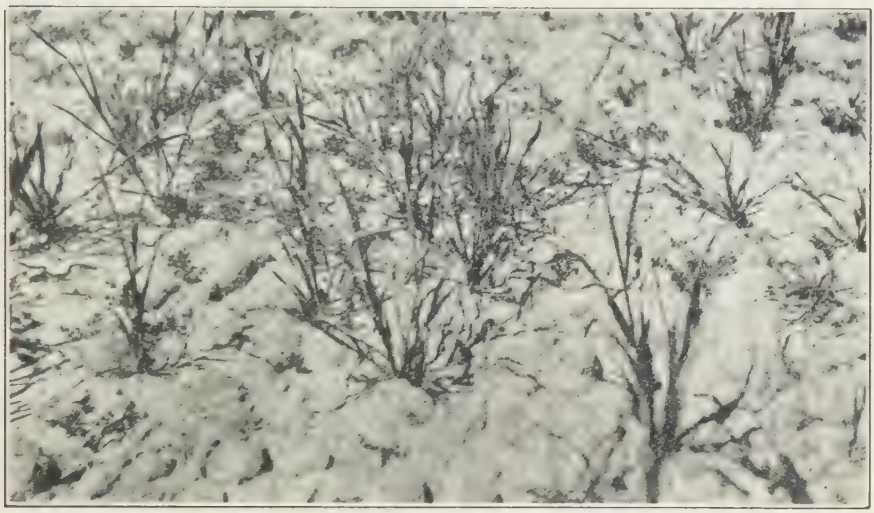

FIG. 2. GROUND IN 12-ACRE BLOCK FROM WHICH A HAY CUT OF OATS AND TARES WAS TAKEN.

Cleaner than land in Fig. 1, but a fair number of couch-plants still present.

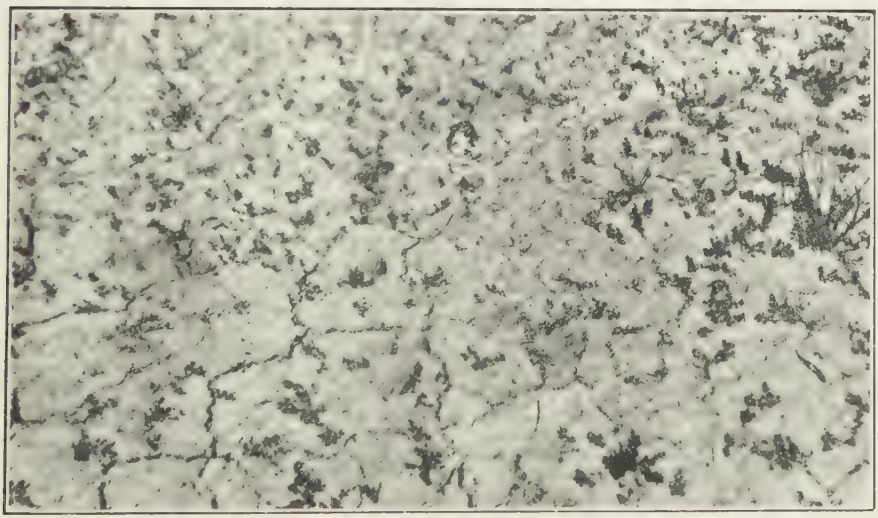

FIG. 3. GROUND IN 6-ACRE BLOCK FROM WHICH A SEED CROP OF TARES WAS TAKEN.

Note practical disappearance of couch—the small plants seen being seedlings of scarlet pimpernel, a relatively harmless weed.

TESTING OF PUREBRED DAIRY COWS.

JANUARY CERTIFICATE-OF-RECORD LIST.

W. M. SINGLETON, Director of the Dairy Division.

IT was hoped that the appended list—giving particulars of certificates issued in January—would complete the publication of records gained in the calendar year 1925. Owing, however, to the delay of a number of breeders in reporting dates of calving subsequent to test, or in returning declarations of milk-weights, &c., there are still a considerable number of records outstanding. It is expected to publish the closing list in next month's *Journal*.

While the present list does not include any new class-leaders, there are several good performances. It will be noted that one Jersey, four Friesians, and one Milking Shorthorn have each yielded over 700 lb. butterfat.

LIST OF RECORDS.

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS.						
Junior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Woodstock Finality ..	Mrs A. Banks and Son, Kiwitea	1 280	240·5	365	10,267·8	566·08
Erinview Perfection ..	J. Murray, Woodville ..	2 16	242·1	365	9,521·2	532·22
Glyndyfrdwy Victoria	P. McNaughton, Morrinsville	2 50	245·5	365	8,565·4	531·98
Gay Twylish ..	A. Devine, Tamahere ..	2 55	246·0	364	8,070·4	521·83
Carhuduff Oxford Lily	J. O'Donnell, Bunnythorpe	2 5	241·0	365	9,422·1	490·62
Mountain View Goldie	H. C. Rogers, Mangatoki ..	2 3	240·8	365	8,868·0	450·82
Makanui Lady ..	H. G. Livingston, Kiwitea ..	1 315	240·5	365	7,335·7	430·90
Linwood Molina ..	W. V. Hosking, Stratford ..	1 354	240·5	310	7,777·6	425·65
Tozzie	J. A. Pettigrew, Pihama ..	2 20	242·5	365	7,428·5	407·20
Grasmere Glitter ..	H. J. Berry, Kaupokonui ..	1 332	240·5	365	7,936·8	385·88
Rewa Macaroni ..	W. H. Booth, Carterton ..	2 44	244·9	365	6,708·4	376·12
Dainty's Respect ..	B. Hey, Riverlea ..	2 14	241·9	340	7,100·2	374·75
Alzie	J. A. Pettigrew, Pihama ..	1 349	240·5	365	6,785·5	370·53
Curzal	J. A. Pettigrew, Pihama ..	2 33	243·8	365	6,385·5	364·50
Pine Bank Viola's Goldie	J. Meuli, Normanby ..	2 16	242·1	365	7,009·0	357·63
Clarissa's Gold ..	J. S. T. Short, Hawera ..	2 63	246·8	330	7,733·8	355·48
Eileen Joy ..	F. V. Bryant, Ruawhata ..	1 311	240·5	335	7,410·6	351·08
Grasmere Maiden ..	H. J. Berry, Kaupokonui ..	1 342	240·5	365	6,465·0	346·56
Ringlet's Dairy Maid	F. V. Bryant, Ruawhata ..	1 336	240·5	325	5,642·5	339·46
Consuela	W. V. Hosking, Stratford ..	1 340	240·5	323	5,852·8	323·29
Grasmere Endowment	H. J. Berry, Kaupokonui ..	1 310	240·5	270	5,893·6	275·96
Grasmere Ideal ..	H. J. Berry, Kaupokonui ..	2 15	242·0	288	5,329·0	253·80
Senior Two-year-old.						
Floral Eminent* ..	G. E. Yelchich, Waiuku ..	2 248	265·3	365	10,359·2	597·43
Riverswood Bright Eyes	J. Nicolson, Kaupokonui ..	2 237	264·2	365	8,827·0	452·57
The Gay Empress ..	Mrs. C. Waterhouse, Waverley	2 344	274·9	343	8,926·7	426·22
Noble's Girlie ..	B. Hey, Riverlea ..	2 123	252·8	365	7,878·2	413·48
Makanui Rachel ..	H. G. Livingston, Kiwitea	2 107	251·2	365	7,149·5	375·77

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
	JERSEYS—*continued.*					
Three-year-old.		Yrs. dys.	lb.		lb.	lb.
Hurden Queen ..	G. E. Cowling, Manaia ..	3 339	310·9	365	8,703·4	571·51
Woodstock Free Lady	Mrs. A. Banks and Son, Kiwitea	3 18	278·8	305	9,051·7	502·65
Some Girl	J. E. Rae, Taneatua ..	3 354	312·4	365	9,181·4	487·21
Pine Bank Bonny Maid	J. Meuli, Normanby ..	3 322	309·2	365	6,686·9	401·40
Four-year-old.						
The Real Lady ..	G. E. Cowling, Manaia ..	4 349	348·4	314	8,352·8	517·01
Kate's Violet ..	F. Phillips, Otorohanga ..	4 324	345·9	365	8,267·1	440·18
Mature.						
Willow Bank Molly ..	J. O'Donnell, Bunnythorpe	6 77	350·0	365	15,584·6	776·59
Orange Dale's Larkspur	W. J. Hall and Son, Matatoki	5 57	350·0	365	10,501·5	629·57
Miro Meadows Countess	A. A. Ward, Tariki ..	5 332	350·0	365	9,518·5	538·02
Sappho's Model ..	S. Dale, Fairlie	6 363	350·0	307	8,686·1	535·56
Trethella's War Baby	F. Phillips, Otorohanga ..	6 86	350·0	365	9,841·2	529·41
Bob Tail	J. S. T. Short, Hawera ..	6 154	350·0	365	9,727·8	524·75
Red Gold	G. E. Cowling, Manaia ..	8 335	350·0	365	8,802·8	522·09
Maori Thora ..	J. Poletti, Bell Block ..	7 55	350·0	365	9,474·3	505·33
Rose of the Meadows	G. E. Cowling, Manaia ..	10 136	350·0	365	9,560·5	493·98
Orchestra	J. S. T. Short, Hawera ..	8 17	350·0	365	9,269·4	486·74
Coy Kilcoy	C. Stevens, Maungatapere ..	5 22	350·0	365	8,314·2	479·21
Majesty's Hopeful ..	Mrs. S. R. Lancaster, Palmerston North	6 261	350·0	365	10,143·4	458·12
Majesty's Dewdrop ..	F. Phillips, Otorohanga ..	7 342	350·0	365	10,075·7	453·21
Una's Zealous ..	A. S. Lamb, Tatuanui ..	6 323	350·0	347	7,764·2	447·11
Oakvale's Starlight ..	A. S. Lamb, Tatuanui ..	5 362	350·0	365	7,719·3	445·50
Maori Magpie ..	J. Poletti, Bell Block ..	6 340	350·0	312	7,276·0	390·95
	FRIESIANS.					
Junior Two-year-old.						
Ngatoro Johanna Princess*	C. W. Baldwin and Sons, Inglewood	2 25	243·0	365	18,725·7	619·05
Ormsby Hartog Queen*	John Court, Ltd., Auckland	2 28	243·3	365	13,536·2	484·19
Johanna Posch of Oakview*	H. R. Green, Kairanga ..	2 139	254·4	293	12,205·0	450·26
Colinton Venus* ..	R. Colee, Greendale ..	1 317	240·5	365	10,069·1	390·24
Hanley Gem ..	G. H. Hassall, Clarkville ..	2 84	248·9	365	10,072·9	333·39
Senior Two-year-old.						
Tinie Evergreens* ..	John Court, Ltd., Auckland	2 364	276·9	358	13,313·7	389·03
Junior Three-year-old.						
Bainfield Sylvia Betty*	R. K. Macdonald, Edendale	3 120	289·0	334	11,368·8	391·09
Friens Hengerveld Gipsy†	D. Dickie, Wellington ..	3 55	282·5	286	9,338·8	343·81
Ellerlea Ena Minto de Kol*	A. C. M. Finlayson, Kamo ..	3 59	282·9	160	8,134·4	294·56
Senior Four-year-old.						
Domino Posch of Oakview*	H. R. Green, Kairanga ..	4 327	346·2	365	21,734·8	799·28
Pietertje Dutchland Abbekerk*	H. R. Green, Kairanga ..	4 295	343·0	365	20,945·0	714·35

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
FRIESIANS—*continued.*						
Senior Four-year-old—continued.		Yrs. dys.	lb.		lb.	lb.
Dominion Daughter of Domino	Central Development Farm, Weraroa	4 337	347·2	365	10,092·8	384·76
Mature.						
Rosevale Burkeyje Sylvia*	H. North and Sons, Omimi	7 0	350·0	365	19,571·5	724·65
De Kol Lulu of Hawkridge*	Piri Land Company, Auckland	6 355	350·0	365	18,701·4	705·26
Fairmont Pietertje Lady*	James Hart, Tatuanui ..	5 49	350·0	365	20,184·9	688·96
Glenmore Pearl* ..	R. S. Riddler, Ohakune ..	11 2	350·0	365	15,099·7	582·41
Manor de Kol Beets of Ashlynn*	F. G. Wayne, Parawai ..	10 16	350·0	365	17,071·7	578·86
Dominion Miss Mierlo	Central Development Farm, Weraroa	6 29	350·0	348	16,562·5	554·42
Friens Mercedes† ..	D. Dickie, Wellington ..	5 300	350·0	365	15,301·2	493·75
Colantha Tirania Segis 2nd	J. C. O'Rorke, Opunake ..	5 325	350·0	365	14,072·1	450·89
Pietertje Queen Manola*	Matangi Friesian Farm, Matangi	6 44	350·0	233	10,569·1	440·73
MILKING SHORTHORNS.						
Junior Two-year-old.						
Willowbank Tangi's Floral 2nd	W. J. Holmes, Runciman ..	1 353	240·5	365	11,108·9	441·37
Junior Four-year-old.						
Willow Banks Beryl†	W. H. Simms and Sons, Ltd., Christchurch	4 42	317·7	365	9,993·1	475·19
Sunnymeade Pearl ..	W. J. Holmes, Runciman ..	4 61	319·6	365	9,811·6	437·26
Braebank Red Lady	W. J. Holmes, Runciman ..	4 23	315·8	306	8,990·7	359·19
Mature.						
Kaitawa Meg 2nd† ..	J. H. Mason, Reid's Line ..	6 342	350·0	365	17,141·5	716·04
Matangi Winsome's Wonder†	W. H. Simms and Sons, Ltd., Christchurch	5 77	350·0	363	13,876·2	615·59
Rouken Glen Belle ..	Wood Bros., Karaka ..	6 122	350·0	365	13,685·3	558·90
Zest of Waimea ..	R. V. Brown, Weraroa ..	7 335	350·0	365	12,776·2	535·14
Matangi Jimmy 2nd..	R. V. Brown, Weraroa ..	5 41	350·0	365	12,480·3	526·95
Waimea Laurel ..	R. V. Brown, Weraroa ..	5 359	350·0	326	11,651·0	500·26
Pukerimu Dolly 14th	John Fisher, Pukerimu ..	8 263	350·0	306	9,363·6	363·31
AYRSHIRES.						
Two-year-old.						
Maesgwyn Mignonette†	C. M. Williams, Ohoka ..	2 93	249·8	365	9,844·1	416·79
Maesgwyn Clover† ..	C. M. Williams, Ohoka ..	1 347	240·5	365	12,047·3	386·17
Four-year-old.						
Maesgwyn Joy† ..	C. M. Williams, Ohoka ..	4 283	341·8	349	15,160·6	583·12
Mature.						
Generosity of Woodlands	Robertson and Blackley, New Plymouth	7 289	350·0	365	12,929·3	570·48

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat reqd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
Second-class Certificates.						
Jerseys.						
Junior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Twinks	L. and J. Griffith, Weraroa	2 17	242·2	365	10,203·2	555·54
Sea View Polly ..	G. H. Bell, Oakura ..	1 333	240·5	365	6,207·9	306·00
Three-year-old.						
Pinewoods Silver Link	G. H. Bell, Oakura ..	3 349	311·9	365	10,360·2	630·39
Mature.						
Ulysses' Bilberry ..	G. H. Bell, Oakura ..	5 303	350·0	365	8,172·4	503·82
Friesians.						
Mature.						
Pareora Gyda* ..	A. S. Elworthy, Timaru ..	7 3	350·0	365	16,252·4	528·63

OCCUPATION AND UTILIZATION OF LAND IN NEW ZEALAND.

THE following table summarizes the condition of occupied land in the Dominion for 1924 and 1925:—

	1924.	1925.
	Acres.	Acres.
Orchards, market gardens, vineyards, nurseries, and seed-gardens	34,567	32,747
Crops	1,681,922	1,768,303
Area occupied by residences, outbuildings, gardens, &c.	61,648	63,206
Fallow land	160,945	124,459
Sown grasses	16,447,570	16,450,625
Phormium tenax (New Zealand flax)	43,180	54,814
Tussock and other native grasses	14,806,237	14,470,990
Fern, scrub, &c.	3,827,517	4,054,760
Plantation	66,056	71,218
Standing virgin bush	4,411,730	4,331,333
Barren and unproductive land	2,031,192	2,209,917
Totals	43,572,564	43,632,372

In this table "barren" land is defined as that which is incapable of being put to profitable use, and not merely that which is barren because unused. Types of this land are mountain-tops, cliff-faces, shingle-beds, &c. It must be recalled that this table does not profess to give the condition of all land, as the total area of the Dominion is 66,390,262 acres, whilst the area occupied in 1925 was returned as 43,632,372 acres—a difference of 22,757,890 acres.

—*Census and Statistics Office.*

HON. O. J. HAWKEN,

MINISTER OF AGRICULTURE.

Appointed 18th January, 1926.

SEASONAL NOTES.

THE FARM.

AUTUMN SOWING OF PERMANENT PASTURE.

At the higher altitudes which are subject to heavy frosts spring sowing of pastures is preferable, particularly if the mixture used is heavy in clover content. On coastal lands and the lower country generally it will be found as a rule that the best pastures are obtained from autumn sowings, and March is probably the best month for this purpose. A mixture suitable to the soil and locality should be chosen, and great care should be given to the selection of the seed to ensure that nothing but the best is purchased, and that it is reasonably free from weeds and of good germination. The question of cover-crops is much discussed, but it may be accepted as a general principle that pasture mixtures are best sown alone. The exceptions are very late autumn sowings, or where the field is in a very exposed position. In cases of this sort it is permissible to put in a bushel of white oats or barley. Algerian oats are not very suitable, as they are slower in coming away and persist rather long in the spring. For cultivated land about 40 lb. of seed is a suitable sowing per acre. This will, of course, be dependent upon the mixture, but as a rule somewhere between 35 lb. and 45 lb. will prove sufficient.

Standard mixtures for various conditions of soil and situation have been published from time to time in the *Journal*, and many will be found in the Department's "Grasslands" bulletin. Local experience must always be given due weight, especially in connection with mixtures for unploughable hill country. The district Instructors in Agriculture are always ready to advise in cases of doubt.

In order to grow good pasture, land must be in a good state of fertility, and, if the soil is at all run out or low in plant food, fertilizers should be applied with the seed or put on as soon as possible after sowing. From 1½ cwt. to 3 cwt. of any good phosphatic manure is suitable, such as superphosphate, basic super, basic slag, or half-and-half mixtures of super and ground rock phosphate or super and blood-and-bone. On ploughed land, if the seed-bed has been well prepared and consolidated, covering the seed with a light set of tine harrows will give a satisfactory result, nothing more being required. If, on the other hand, the seed-bed is inclined to be loose and dry it is best to complete operations with the Cambridge roller.

FORAGE CROPS.

The sowing of cereal mixtures as advised last month should be pushed on, so that they may be well established before cold weather sets in. Oats and vetches sown now may be used as green feed for sheep or milking cows in the spring. Where the system of farming tends to eliminate leguminous crops by the continuous growth of cereals and crucifers, oats and vetches are particularly valuable for keeping up the nitrogen content of the soil and ensuring high fertility. Cape or Black Skinless barley can still be sown for feed in autumn.

For winter feed, especially where turnips have failed or are at best uncertain, Algerian oats may be sown.

Western Wolths or Italian rye-grass sown now provides good spring feed, and may later be shut up for a seed crop. Temporary pastures of Italian rye-grass and red clover may be laid down on land that does not become too wet in the winter. This can be grazed in May or June, and again in the spring, periods which are very important from the feeding standpoint. Dairy cattle that can be given a good start for the winter will generally maintain their condition.

Maize and Japanese millet should be fed with the intention of utilizing all before the middle of April, and if surplus crops of these are likely to occur they should be converted into ensilage. It is a good policy to plough the land immediately maize, millet, and soft turnips are removed. This will keep down the weeds, and it also saves time when the land is prepared for spring feed.

In the North, sowing of the hardier varieties of soft turnips, such as Devonshire Greystone, for winter feed may be continued in March.

RED CLOVER SOWN ON WHEAT.

Red clover sown across the wheat crop in the spring generally comes away well after the cereal is harvested, if there is sufficient rain. It can be very profitably utilized, together with second growths of rape and kale, for flushing ewes before tupping. If the crop has undergone dry conditions during summer, inspection may show that there are a good number of weakly clover-plants in the stubble. By keeping the sheep off the field, and later top-dressing with 1 cwt. super when a good rain is assured, this clover will be very useful for spring feeding. Ewes milk particularly well on it. Later the crop may be spelled and then fed in breaks to fatten the lambs. The last breaks are the best for this purpose—that is, when the clover hardens off and is in full flower. Care should be taken not to allow sheep to become engorged with clover, especially when rank and after rain. A grass-pasture run-off should be provided.

AUTUMN SKIM-PLOUGHING.

Under Canterbury conditions too much emphasis cannot be laid on the importance of early autumn skimming. Stubble land of oats, and oats and vetches, and later of wheat and rape, should be worked up as soon as harvesting operations will allow, so as to kill weeds, conserve moisture, and obtain that deep easily worked tilth which means profitable crops. On farms where the land is still so hard as to make skimming difficult with a team, the work of a strong rigid-tine cultivator, or disks with plenty of cut on them—tractor-drawn—should pay handsomely.

THE LINSEED CROP.

The linseed crop will be ready for harvesting early in March. It should be allowed to remain in stook until sufficiently dry; this will take from two to three weeks. The crop may be threshed from the stook or be stacked. Evidence to hand this season in Canterbury indicates that linseed does best when sown on lea land. Several cases have indicated the undesirability of following turnips

with linseed. The general impression that linseed is an exhausting crop is not borne out by Canterbury experience, as it is frequently found to be a good preparation crop for wheat.

Growing of "Bill Moose" seed is increasing, as the heads of this variety are considerably larger than those of the ordinary type. Owing to the seed itself being much larger, sowings of from 40 lb. upwards should be made, whereas with the old type of linseed from 25 lb. to 30 lb. prove quite sufficient.

LUCERNE.

Lucerne sown last spring should be ready for a second cut about the end of the coming month, and if the weather is dry this cutting should be followed by two or three strokes of the tine harrows or a very light cultivator. It may be recommended to then drill in 1 bushel of Algerian oats with 1 cwt. super per acre and leave the stand until spring. The oats will shelter the young lucerne and keep down the grass and weeds. Old lucerne stands that have not already had attention should be thoroughly cleaned up as advised in last month's notes. When properly cleaned a method well worth consideration is to drill in 1 bushel of oats or Italian rye-grass, which will fill up all bare ground and help to suppress undesirable growth. This will give a good early crop for feeding out or making into ensilage. Several stands treated in this manner in the autumn of last year gave up to 12 tons of green material per acre in the spring. Careful observations indicated that the introduction of the oats or rye-grass had very little effect on the subsequent growth of lucerne. In any case, such effect was confined to the first cut after the oats were removed, and this was more than compensated for by the extra weight of material obtained and the improved condition of the land.

Established stands of lucerne may be grazed moderately from now on till the end of the growing season, but young stands are better not grazed at all during the first year. Where it is considered that a lucerne stand requires lime, this is best applied in autumn.

IRRIGATION FARMING.

In Central Otago, settlers practising irrigation must make provision to carry out the final watering of their land in March, as the supply of water from the races will be cut off at the end of that month. This especially applies to the soaking with water of uncultivated land intended to be broken up. There is no doubt that by this means ploughing is made easier and more satisfactory. A start should be made to break up new land, and this operation not left till winter, when in all probability the ground will be frozen too hard for ploughing.

WATERING-PLACES FOR STOCK.

Stock at this time of the year often suffer from an inadequate supply of drinking-water. The falling-off in milk-yield, often attributed to a decrease in the quality of the grass, can be partly traced to this deficiency. Watering-places should be cleared out and made accessible to stock by the formation of a sloping bank. A load or two of gravel covering the bed of the stream and the approach to it does much to keep these places clean. —*Fields Division.*

THE ORCHARD.

FRUIT EXPORT.

THE efforts of commercial fruitgrowers will now be concentrated on the harvesting of the season's crop, and in some localities the preparation of apples and pears for export will be foremost.

The methods employed in this branch of the business vary considerably. Where the quantity handled is not large the fruit is usually picked and packed by the grower himself or under his own personal supervision, and picking and packing can be carried out with the idea that any extra care and time spent at the picking will be a distinct advantage at the grading and packing table. In early packings every care should be taken that all fruit, as far as possible, is above the minimum size allowed for the variety, otherwise the small fruits are wasted; whereas if left on the tree they would be included in the next picking, having then attained the size required.

Likewise all fruit below standard can be discarded at the first handling. This is not always done, and much time is wasted at the grading and packing table which could be avoided if such fruit was thrown out when picking. Where large quantities are being harvested, and the fruit graded and packed in community packing-sheds, or by packing contractors, joint action between pickers and packers is of great importance. It is not enough that pickers should be concerned only in making available a supply of fruit for the shed, but that the cases should be delivered containing the least possible quantity of useless fruit.

For those who have not had previous experience in export business a few hints may be useful regarding handling of the fruit generally. If picking-bags are being used, be careful not to overfill them, and do not be in too great a hurry when tipping the contents into the boxes. Carelessness results in scratches and stem punctures. Pick direct into the cases whenever convenient, but, if they are export cases, see that they are not unduly soiled in the process. Sometimes accidents will happen and cases of fruit are spilled. Do not fancy that the contents of these are not bruised, and include them in the bulk. Put them on one side for a while, and then sort carefully. Before grading or packing, study carefully the regulations covering these matters. The Orchard Instructor for the district will give his advice on the practical side should it be required. There are many little points in connection with fruit export which do not strike the beginner, but have been found out by experience to be of value in the process of assembling, such as the proper construction of the cases, the use of certain-sized papers, proper methods of wiring, care in labelling and stamping, the proper use of wood-wool, and other items that make for successful working.

LOCAL MARKETING.

Though the foregoing notes deal exclusively with export, the writer is well aware that this concerns only about 25 per cent. of the production, and that our own markets must receive every consideration as regards methods employed. One cannot but be

impressed with the fact that experience is teaching that greater concentration must be directed to this end. Universal and uniform grading, and the elimination of that class of fruit characterized as culls from our present lower grades, appear to be essential. At present one can only emphasize the necessity for careful attention on the part of growers in the disposal of their local-market fruit, whether for private sale or on the open markets of the Dominion.

SPRAYING.

The later varieties of apples which will not be picked for several weeks may still receive arsenate of lead for the control of leaf-roller and codlin-moth, where such precaution is still necessary. Also where red mite is still to be feared, lime-sulphur treatment may be continued; if used alone this should not cause spray-stains. Attention is also drawn to the possibility of a late infection of black-spot on such varieties as Statesman, Dougherty, Sturmer, Cleopatra, Yates, and possibly others in some localities. Lime-sulphur may still be applied to guard against loss from this cause should circumstances be favourable for the development of spot.

—J. H. Thorp, Orchard Instructor, Nelson.

CITRUS-CULTURE.

Work for the coming month will consist of maintaining a clean state of cultivation, with the soil constantly well worked. A further application of bordeaux, 4–4–40, is also advisable for fungus troubles. If young scales or thrips show up during this period an insecticidal spray of oil, 1–40, should be applied to prevent them becoming established. Stopping of unduly extended young growth should also be attended to.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

CULLING.

MARCH is a busy month on the poultry plant, for at that period much important work must be carried out. In the first place, the main culling of the flock should be undertaken, and it is of the first importance—with wheat at its present price—that every inferior bird be weeded out.

For those who have not studied laying form throughout the season some general points may be stated that will serve as a guide towards culling out the poor layers. Other things being equal as to the time of hatching, and when the flock has received uniform treatment in regard to feeding and general management, it will usually be found a safe course to discard the birds that moult first, and to retain the late moulters either for breeding or laying purposes. Other indications of poor laying-power are overfatness (above the standard weight of their breed), well-kept plumage, and any signs of weak constitutions, such as a dull, sunken eye, loose feathering, sluggish appearance, lack of abdominal development, and anything denoting unhealthy condition. In the case of the breeds with yellow legs, such as Leghorns, Plymouth Rocks, &c., it will generally be found at this

season of the year that those which have lost the deep-yellow colour—the legs having become more or less white and bleached-looking—are the best layers and the strongest birds in the flock, whereas those with legs of a rich yellow are the drones. It is well to reiterate, in view of the high cost of food, that no sentiment must be allowed to enter into this essential work of weeding out unprofitable stock.

A great weakness on some plants is the practice of holding on to old male birds. Very often the general appearance of these is sufficient to indicate that they will be little, if any, use for another breeding season. Such stock are a constant drain on the profits. If a male is not worth using again he should be got rid of as quickly as possible. It should be needless to mention that all surplus cockerels that have attained a marketable age—four and a half to five months—should be marketed without delay.

Not only does efficient culling save food without reducing profits, but it also does away with overcrowding, one of the worst faults connected with poultry-keeping.

THE WINTER LAYERS.

It is now full time for all pullets to be placed in their permanent winter quarters, as it is always best to have them well accustomed to their surroundings before they reach the laying-point. Any change of quarters or food when they are nearing that stage is liable to cause a false moult. In addition to providing uniform conditions in this respect, special care should be taken for the comfort of the stock, so that a maximum egg-yield may be produced. Everything, in short, should be done to prevent the birds receiving a setback.

An abundant supply of sound grain material, a daily ration of both green and animal food, also grit, crushed oyster-shell, and provision for dusting-places are of great importance. Also the quarters should be kept clean, and the floor well covered with scratching-material, in which the whole grain ration should be fed to induce exercise. Above all, care should be taken that the birds are not compelled to sleep in a draught, or colds will soon appear at the expense of the egg-yield. Present indications are that fresh eggs will command a high level of value during the coming winter. Thus any time spent now in making the pullets comfortable and keeping them in a healthy thriving condition should be well repaid.

THE BREEDING-HENS.

The importance must be emphasized of selecting next season's breeding-hens before the moulting-period generally sets in. Indeed, if this important work is delayed now it will be impossible for it to be carried out to the best advantage at a later date. This is because if it is left till the flock has fully moulted the signs indicating that a hen has laid well during the past season (and is most likely to do so in the future) will have vanished. In choosing the best hens to breed from it is the long-season layers—in other words, the late moulters—that are most desired. This, however, is not to say that all late moulters and heavy layers are necessarily ideal breeding-stock. Something more is required. In addition, the bird should conform to the

utility-standard requirements of the breed it represents, both in breed type and weight. That is to say, it should be a slightly larger specimen than the average bird kept in a laying-flock. The great essential of all is the possession of undoubted constitutional vigour, sign-posts to which are a clean face, bold prominent eyes, tight feathering, a well-developed crop, and an active businesslike appearance.

After selecting the best breeding specimens and carefully marking them everything should be done to keep them in the best of health. There is nothing more conducive to this than a good range under the most natural conditions possible. This will give the birds an opportunity to recuperate and build up their bodily vigour before being called upon to lay eggs for hatching purposes. One of the great essentials in the breeding of profitable stock is not only having the right class of parents, but in handling these to the very best advantage right up to mating-time.

TUBERCULOSIS.

Now that the hens are finishing up an exhausting laying season and are not in a vigorous condition they are liable to become affected with this dreaded disease should they come in contact with the germ. A sharp lookout should therefore be kept to detect birds showing signs of being affected. As a rule the first outward symptom is an unthrifty appearance and a rapid wasting of flesh which is most noticeable surrounding the breast-bone, the latter standing out as a sharp ridge. It will also be observed that the bird has a listless appearance and seldom mixes with other members of the flock. As the disease advances, a yellow and in some cases a mixed green diarrhœa sets in. Another common symptom is a limp, generally on the right leg. Under post-mortem examination the liver will usually be found spotted with yellow nodules. For this reason the disease is often termed by poultry-keepers "spotted liver."

It is useless trying to doctor a bird affected with tuberculosis, and all that show signs of being affected should be killed and burnt. Prevention is the one and only safe course of dealing with this disease. The first essential is to breed birds with the necessary constitutional vigour to resist the infection. Then, the value of good feeding and clean, well-ventilated houses is most important, while, above all, the runs should never be allowed to get into what is termed a poultry-sick condition. A double run to each house, whereby one can be spelled, cropped, and allowed to sweeten while the other is being used, is an essential for the maintenance of clean ground and a healthy thriving flock.

BROODING DUCKLINGS.

Several cases have come under my notice lately of ducklings losing the power of their legs during the brooder stage. This condition is usually the result of allowing the birds to sleep in damp quarters. Although ducks are a water fowl, the artificially produced duckling will cease to thrive if compelled to sleep on damp bedding or where a moist atmosphere exists. Once a duckling loses the power of its legs little or nothing can be done for it. It is merely a question of prevention by checking everything that tends to create a moist atmosphere. In the first place, the drinking-vessels should be placed

well away from the sleeping-quarters, a practice that will help to keep the latter dry; also ample ventilation should be provided and the quarters kept clean. Do not on any account overcrowd ducklings by placing more in the brooder than it can properly accommodate. Work only with numbers that can be handled with absolute confidence. Overcrowding and insufficient ventilation are bad enough, but where this is accompanied by insanitary conditions disastrous results are sure to follow. An even degree of heat, good ventilation, and cleanliness are essential factors in rearing brooder ducklings.

—*F. C. Brown, Chief Poultry Instructor.*

THE APIARY.

FINAL EXTRACTING.

WHERE extracting has been delayed for any reason it is advisable to use great caution in removing the honey. The combs should be removed as expeditiously as possible, and care must be exercised not to incite the bees to rob by keeping the hives open longer than it is necessary to remove the surplus. A hasty examination of the brood-chamber should be made in case it is found that the bees have not filled the combs in the lower story with honey. If empty or partly filled combs are found it is highly important that they be replaced with good combs of honey from the super. On no account attempt to extract any honey from the brood-chamber. Do not leave combs lying about or expose vessels that have contained honey. Unless caution is exercised in regard to these details, when the final extracting is being done the beekeeper is more than likely to start the bees robbing in a wholesale manner.

PREPARATION FOR WINTER.

The time is at hand when it is of paramount importance that proper preparation be made for winter. If the colonies are to winter in good order, so as to escape the abnormal winter losses which sometimes occur, then it behoves the beekeeper to attend to the leading factors that produce successful wintering. The attendant evils of neglect are starvation, spring dwindling, and poor colonies, these latter being of little account when the next season's crop arrives.

There are many factors in preparing the colonies for winter, and among the most important which make for success are a strong cluster of bees, a good queen, plenty of good stores, and protection. It is safe to say that too little attention is paid to wintering the colonies with strong clusters of young bees. Having secured a crop of honey, and noting that the colonies are strong in bees, the beekeeper is satisfied to trust to chance. At the close of the season the colonies are likely to contain a large force of bees, but the majority, having helped to gather the season's crop, are old, and in consequence cannot be taken into account in wintering the colony. As a result, unless large numbers of young bees are being raised to take the place of the old bees, the colonies will seriously dwindle in the spring or become a total loss in the winter. Every effort must be made to keep up breeding well into the winter, and it is often advantageous to stimuate the colonies by autumn feeding.

Next in importance to having a strong cluster of young bees is the necessity for the colony to be headed by a good queen. Too little attention is paid to superseding failing queens. A queen that has laid vigorously during the honey season is likely to become worn out and her powers of reproduction diminished. In all cases these queens should be replaced and a vigorous young mother supplied. It often happens that the bees recognize a failing queen, and set to work to supersede her, but this work should be anticipated by the beekeeper. Other things being equal, stocks headed by a vigorous mother are likely to keep up late breeding, with a result that the colonies will come out in the spring with a prolific queen, and the loss attendant upon queenless hives will be greatly diminished.

If the beekeeper studies his interests and the welfare of his bees he will note that every colony goes into winter quarters with plenty of good stores. This is a most important factor in successful wintering, and upon it depends largely the staving-off of starvation which faces the bees during the months which follow. The colonies that are supplied with honey winter safely and build up early in the spring, and are ready to take advantage of the nectar from the early-flowering plants. Beginners often ask how much honey should be left for the bees to winter on. The amount necessary must to some extent depend upon locality, and care must be exercised, more particularly in the South, to provide sufficient so that winter feeding may not have to be resorted to. In the North, winter feeding may be successfully carried out, as there is not the same risk in breaking up the clusters as there is in the extreme South. In no case should a colony be left with less than 30 lb. of sealed honey, and it is wise to increase this amount to 40 lb. Abundance of stores is essential if winter losses are to be eliminated altogether.

Another important factor in the safe wintering of bees is that of protection. This may be provided for bees by housing them in a good watertight hive and protecting them by good shelter hedges or fences. Great annual winter losses occur in this country through lack of attention to hives, more particularly to the roofs. Leaky roofs are an abomination, and should not be tolerated under any circumstances. By allowing the roofs to leak the mats and hives become damp, and the consequent drain on the stores is largely in order to keep up the heat of the cluster for safe wintering. It is safe to state that where the bees are kept dry the amount of food consumed to keep up the heat of the cluster will be small as compared with the stores eaten by the bees where proper protection has not been afforded by the beekeeper. New Zealand in general being a wind-swept country, it behoves the beekeeper to see that the bees are located in a sheltered position. Cold winds militate against brood-rearing, while they also prevent the bees from taking a cleansing flight during the spring months.

CARE OF COMB-HONEY.

There are factors in the proper treatment and care of comb-honey which the producer is apt to overlook when putting his honey on the market. Usually the practice followed is to despatch the crop to market, where it is sold, to be afterwards graded and cleaned by buyers who are alive to the demands of the local market. These buyers obtain a better price by grading and cleaning the comb-honey,

whereas the producer can, by employing proper methods, demand an increased price. Comb-honey should be fully capped before removal from the hive, and it should not be left until its white appearance is destroyed by travel stain, this being caused by the constant traffic in the hive. When the sections are removed they should be stored in a warm, dry room, as low temperatures hasten granulation, and granulated comb-honey is not likely to meet with ready sale. Moreover, comb-honey stored in a cold, damp place is apt to "weep" (or absorb moisture from the atmosphere), forming beads on the surface of the comb, and in the course of time becomes sour, thus destroying its marketable value. As opportunity allows, the sections should be cleaned of all propolis and stain, and this is best done by scraping the sections with a knife, and the operation finally completed by sandpaper. Care must be exercised not to damage the cappings of the comb and thus destroy its attractiveness.

Before forwarding the honey to market it should be carefully graded, and finally packed in cartons for the market. By the use of cartons the sections are secured from dust and insects, and present an attractive appearance when offered for sale, besides being far less liable to breakage. In order to ensure safe transit, excellent shipping-cases can be purchased from the hive-dealers. These cases are fitted with corrugated-paper cushions, which materially reduce the breakage from rough handling. A feature of these section crates is a sliding-cover which enables the honey to be readily examined. The crates are appreciated by the retailers, and at the same time help to increase the average price to the producer.

E. A. Earp, Senior Apiary Instructor.

HORTICULTURE.

VEGETABLE-GROWING.

Autumn rains will encourage strong growth of weeds and crops. Crops half-grown will suffer seriously if this competition is allowed to continue. Advantage should be taken of fine weather, and specially bright mornings, to go through crops autumn sown or planted and weed them thoroughly. Crops nearing maturity fully occupy the ground and afford little opportunity for weeds to become established.

If seed of cabbage and cauliflower for early spring cutting is not already sown, prepare beds for the purpose and sow without delay. Prepare also a piece of warm, well-drained land for planting them out during the month of March or April.

On the lighter land and in the more humid districts the main onion crop is sown in March for planting out in early spring. Sow the seed rather deep and thin on clean ground, and afterwards commence the preparation of a piece of moist, well-drained, rich, friable soil on which to plant out the seedlings. These operations need to be carefully timed to suit localities, and the importance of the onion, spring cabbage, and cauliflower crops demands they be carried out in a thorough manner.

Runner beans, marrows, cucumbers, and the like, where cropping well, should be regularly picked over as the crops mature. Generous

watering, feeding, and mulching will often lengthen the cropping-period and increase the returns.

Lift potato and onion crops as soon as they mature and the weather is fine and the land dry. To allow opportunities for harvesting to pass is taking serious risks. If the weather is unsettled, move the onion crop into a dry, open, airy shed to ripen. Where the potato crop has been rogued during summer by marking the plants with sticks, secure the fruits of that labour by sorting out that which is desirable for replanting another season. To allow decayed and broken tubers to be mixed into the bulk sample, as is so often done, is storing up trouble for the future and increasing work. Easy sales and satisfied customers may be made and kept if careful sorters and pickers are engaged and the right grade maintained. Cool, dark, ventilated sheds are best for keeping potatoes any length of time, and then only the soundest stocks should be stored.

Continue to give attention to the permanent crops of rhubarb and asparagus. Some feeding with manures in early spring is too often the only attention they receive besides the close cutting of sticks over a too lengthy season. More important is it to maintain attention during summer and autumn, so that strong plants are built up to ensure good spring growth. Do not allow the plants to become dry; feed them from time to time during the growing-period; and, most important of all, if growing in an exposed situation, protect the maturing growth of the asparagus, especially along the windward side.

Leeks and celery, too, require generous treatment, almost weekly, and never must they be allowed to dry out. Give a little extra attention before earthing up; remove suckers and damaged leaves. Tie the plants up carefully when the foliage is dry, and earth them up when the soil is friable and fine.

Where an abundance of fresh stable manure is available mushroom-spawn may now be planted.

GLASSHOUSE WORK.

Excellent reports are coming to hand from other parts of the world regarding the new method of cyanide fumigation of glasshouses. In the past potassium, and later sodium cyanide, has been used for the purpose of destroying injurious insects in glasshouses. In calcium cyanide, it is claimed, one has a material just as effective, cheaper, easier to use, and practically without danger to the operator. Tomato-growers or others wishing to give this cyanide a trial can receive further particulars on application.

Tomato-growers accustomed to follow on the main crop with a crop of dwarf beans might consider growing French runner beans instead. This practice is spoken highly of by some of those who have tried it.

PREPARATION OF SOIL FOR BOXES.

The preparation of soil for the seed and plant boxes is sometimes deferred until the day it is required. This is most unwise. It is often the cause of those fungi becoming epidemic which cause "damping off," "stem-canker," &c. The stacking and turning of the quantity of soil required for this work is a big undertaking, but

it cannot be avoided, as it is a necessary factor in successful cropping. To the well-decayed fresh loam that should already be on hand, add now sharp sand, manures, and lime, &c., as required, and mix them well, and again from time to time before required in spring. This treatment thoroughly incorporates each ingredient, sets up a suitable fermentation, and encourages the germination of seeds and spores and their ultimate destruction. Seeds sown and plants pricked out into this class of soil can be expected to give good results, with a minimum of those worrying diseases and uneven growth that is such a feature under other conditions. The preparation of this soil should be undertaken without delay—if it has not already been done.

SMALL-FRUITS.

In the small-fruit section, which is so often neglected at this season, returns will be increased considerably if timely attention is given and the important autumn season is made the most of. Clean up strawberry plantings that are to be carried over; spray them with bordeaux, and hoe out weeds and runners, thus assisting the plants to a good recovery from the past fruiting season and putting them in good heart for the next.

Raspberry and loganberry breaks that still carry the old fruiting-canes should have them removed, and the new canes sprayed with bordeaux in which arsenate of lead is mixed. Most blocks of gooseberry and currant bushes would also benefit greatly from the application of this spray at the present time.

TOBACCO.

Crops of tobacco reaching the ripening stage will now be increasing in number. Cutting the leaf on the first fine day after rain is to be avoided, as it is then thin and watery; the gums and other constituents that give the leaf quality are actively secreted only in fine weather. Harvest the leaf with care, remembering that torn, broken, and bruised leaves are at a discount. Especially is this to be remembered in the curing-shed, where leaves should on no account be handled in a dry, brittle condition. Make every effort to get control of the ventilation of these sheds. Where they have been adapted it is sometimes difficult to do this, but until it is done the crop is very largely at the mercy of the weather.

LAWNS AND GREENS.

On the lighter lands, especially in the warmer districts, lawns and greens are best sown down during the month of March. Carry out now the preliminary work of cultivation and thoroughly cleaning the ground, smoothing it out approximately to grade, and letting it settle down to a firm bed. Give it a shallow hoeing from time to time to destroy weed seedlings and maintain a fine surface tilth. Before sowing, true up the surface and consolidate the bed, and then broadcast the seeds. The latter should be kinds and varieties suited to the locality, and free from seeds of weeds.

Lawns in a weedy condition can usually be improved by feeding them at the present time with dressings of the more soluble fertilizers Cut them now only moderately close, and follow this up with ample rolling with a heavy roller.

—W. C. Hyde, Horticulturist.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

SICKNESS IN CATTLE ON FERN-INFESTED COUNTRY.

L. J. W., Whatoro :—

Any information you can give me regarding cattle dying through eating young fern-shoots will be very welcome. The chief symptoms are that the cattle fall away, have a nasty cough, and bleed at the nose; the bowels appear to be normal. What is the cure for this sickness?

The Live-stock Division :—

The symptoms described are not characteristic of what is popularly believed to be fern poisoning. In such cases there is a rise of temperature, blood-tinged discharges from the mouth and nose, blood-stained acute diarrhœa, great depression, coma, and death in from twelve to seventy-two hours after the onset of symptoms. It is possible that your cattle grazing get the ash or pollen of the young fern-shoots into the nostrils, which sets up irritation, causing the animal to rub the nose on stumps, posts, &c., and that this tends to local hæmorrhage. We would advise you to remove the cattle if possible from the fern-infested pastures on to better-class country, and supplement their feed by the addition of a few handfuls of linseed nuts and bran daily until their condition shows general improvement. It would also be advisable to give each affected animal 12 oz. Epsom salts and one tablespoonful of ginger in a quart of oatmeal gruel sweetened with molasses.

BONE-CHEWING COWS.

"IRONSTONE," Halcombe :—

My cows of late have taken greatly to chewing bones and pieces of wood, and I should be glad to know what I should do for this trouble. The cows have been grazing on top-dressed land for some years now.

The Live-stock Division :—

The symptoms certainly point to deficiency disease, and apparently the top-dressed pastures have not proved sufficient in all directions. We would advise the following mixture to be given at milking-time: ½ lb. crushed bone-meal, 1 lb. bran, and a handful of coarse salt.

FOWLS WITH FOOT TROUBLE.

"POULTRY," Methven :—

A few months ago one of my fowls got lame, the foot swelled, and it had somewhat the appearance of club-root in cabbage-plants. Since then half a dozen of the birds have become affected, and are limping. They have a good roost and wide perches. Can you give any reason and remedy for the trouble?

The Live-stock Division :—

The birds are probably suffering from corns. This trouble is usually due to continuous hard pressure, caused by having high perches and a hard floor, whereby the birds injure their feet in alighting from the perch. Hard or stony runs are often responsible, while in odd cases a prick from a thorn, or a piece of fine glass becoming embedded in the foot, will bring about a similar condition. Perches should not be higher than 15 in. from the ground, and there should be ample litter on the floor to provide a soft landing. If the birds are valuable and worth giving personal attention to, painting the affected parts with iodine is a simple and often effective treatment, or they may be treated with a bluestone

solution. Dissolve a piece of bluestone about the size of a walnut in half a pint of hot water, and when the solution is cool dip the affected foot into it. Repeat this daily for a week or more. The birds should not be allowed to perch, and should be provided with soft bedding. Frequent dressings of vaseline or similar preparation may be afterwards applied to keep the feet soft.

SOIL-TREATMENT FOR HALCOMBE FARM.

"IRONSTONE," Halcombe :—

The soil of my farm, near Halcombe, is very heavy; it gets very wet and waterlogged in winter and goes dry and hard in summer. The old pastures seem to be running to rushes, sweet vernal, fiorin, and danthonia. The soil has an ironstone pan, and is full of little pieces of ironstone, and seems to be sour. Would you recommend me to use superphosphate with my crops and for top-dressing, or would basic slag be better ?

The Fields Division :—

Your land is evidently typical of the district, and indicates a bad physical condition of soil from want of drainage and lime. Heavy tenacious clays, being very fine in particle, absorb moisture slowly, and naturally give up surplus moisture as slowly; hence they remain waterlogged for long periods every season, which encourages a plant-growth such as rushes, fiorin, &c., and is detrimental to the growth of the better pasture plants. Under cultivation such soils are very difficult to work satisfactorily, and the growing season is considerably shortened as a consequence of the surplus moisture having to be removed by evaporation (a cooling process), instead of by efficient under-drainage. If the pan mentioned is a sufficient distance from the surface to allow of mole drainage being carried out at a depth of from 18 in. to 20 in. every 8 ft., efficient drainage should be accomplished. This should be followed by liming, at not less than 1 ton per acre of crushed limestone. As well as correcting excessive acidity, lime floculates clay soils and thus opens the top soil, permitting surplus moisture to percolate more freely to the drains. Only under such conditions (good drainage) can a maximum result be obtained from lime or manures. If for any reason such improvement cannot be affected and you have definite knowledge that the soil is very acid, it would be advisable to use alkaline manures such as basic slag or basic super.

COW WITH SCAB ON TEAT.

"J. K.," Matamata :

I have a cow with a hard scab on the side of one teat about the size of a shilling, and beneath the scab the teat is also hard. I have been bathing it with hot water, but this has made no impression. I should be glad to have advice.

The Live-stock Division :—

Probably the best treatment would be to soften the scab by soaking the teat well in hot water containing washing-soda, and then removing the scab, afterwards cleaning the surface and applying some zinc ointment, which you can obtain from a chemist. Treatment would be more successful if you could dry off the cow, because, owing to the difficulty in properly milking a teat that has become hard and tumified, there is always a danger of the quarter becoming infected and mammitis following.

VAGINITIS IN DAIRY HERD.

"READER," Southland :—

I am milking a herd of forty-two cows, and fully half of them have a white discharge lodging on the tail and back parts of the cows. My two-year-old heifers were badly affected, and I have even noticed it on the back parts of a sixteen-months-old heifer. This season four cows and three two-year-old heifers failed to come in, and they were animals that I believed to be in calf, and on all of these I noticed the same symptoms. I washed the cows that were affected frequently with a solution of Condy's crystals, both this year as well as last. A number of

my cows returned to the bull last year, and several are coming back this year. I should be glad of advice.

The Live-stock Division :—

From your description of the symptoms the trouble seems to be infectious inflammation of the lining membrane of the genital passage, known as vaginitis. This disease is seen more frequently in heifers and young cows than in animals of more mature years, and is often the cause of difficulty of getting in calf and sterility, as was your experience last season. It is readily transmitted from cow to cow by the bull, while he himself may show no noticeable signs of trouble. The discharge from affected animals is highly infectious, therefore it is necessary in order to prevent spread that they should be kept apart from the healthy cows. Daily douching with a mild warm antiseptic solution such as Lysol, 1–100, or permanganate of potash, 1–500, alternated with a baking-soda (4 oz. to gallon) or common-salt solution (1 oz. to gallon) is beneficial. Strong irritating injections are harmful. The douching should be continued for some time after the discharge has ceased, and the cows should not on any account be put to the bull until all symptoms have subsided. The tail and hind quarters where the discharge may soil should be frequently washed with any reliable disinfectant. The bull should undergo treatment by clipping off the long hairs at the point of the sheath and injecting a solution of corrosive sublimate, 1–1000, or one tablet to a whisky-bottleful of water. It is necessary that the tablet be thoroughly dissolved and the solution injected at blood heat from a rubber enema. After injection the point of the sheath should be grasped and the fluid worked back so that the solution may come in contact with the whole of the parts inside.

HORSE WITH SEEDY TOE.

"SETTLER," Canvastown :—

I have a young horse affected by seedy toe. The horn is separated from the laminæ considerably, the separation being in some parts 2 in. deep or more. At present the foot so affected is without a shoe, and the horse goes slightly lame on it. What treatment can I give to help it to come right and keep it right ?

The Live-stock Division :—

The condition known as "seedy toe" is really a false growth of horn, due to imperfect secretion. Treatment advised is as follows : Remove all decayed and imperfectly formed horn (this is essential) ; if necessary, have the animal shod with a shoe having shield to protect part where horn has been removed ; apply a cantharides blister (1–8) to the hoof-head.

MINERALS IN CALF-FEEDING.

"PERPLEXED," Alton :—

Having read in the last December issue of the *Journal* that a calf requires 1 oz. of lime per day, and that 1 gallon of milk (the quantity that I feed per day) contains only ¼ oz., I should like to know how this deficiency should be made up. Also, would the addition of a little bone-meal be beneficial ?

The Live-stock Division :—

Although a gallon of milk fed daily to a calf does not contain the necessary amount of lime required to build up its tissue, a certain amount is contained in the herbage eaten, which under ordinary circumstances should supply the amount required. Should there be a deficiency a little finely powdered bone-meal added to the milk would be beneficial. Calves, however, cannot be reared satisfactorily on skim-milk alone. In addition calf-meal should be fed daily. This is probably the best method of adding the necessary ingredients that the young animal requires.

Drainage removes excessive soil-water, and its place is taken by air. Warmth then penetrates the soil and prolongs the growing season. These improvements encourage deep rooting and preserve the crop in times of drought.

WEATHER RECORDS: JANUARY, 1926.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE month of January opened with strong southerly winds, and cold, squally, and showery conditions prevailed on the 1st and 2nd over most of the Dominion, the effect of a severe disturbance which developed off the east coast. Thereafter, however, temperatures were more in keeping with the season, and, though occasional spells of unsettled and wet conditions were experienced, warm and fair weather predominated. Between the 9th and 12th an ex-tropical disturbance which moved down the western coast brought some good rains to both Islands. This was particularly beneficial to Central Otago in terminating a long spell of dry weather.

The most unsettled period during the month was generally experienced between the 20th and 24th. The North Island (particularly its northern districts) was under the influence of a cyclone passing in the north on the 21st and 22nd, and a severe easterly gale, with heavy rain, inflicted considerable damage on orchards and gardens. At the same time a storm area passing in the south caused northerly gales and boisterous conditions over the South Island. Our observer at Pokororo, in the Nelson District, reported that 8·21 in. of rain fell in ten hours on the 22nd, causing a record flood.

The total rainfall for the month was above the average in all but the east-coast districts, and the deficiency there was not so serious as in the previous month, so that conditions generally seem to have been favourable to farming pursuits.

—*D. C. Bates, Director.*

RAINFALL FOR JANUARY, 1926, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	9·28	10	4·50	3·36
Russell	7·49	5	5·15	4·54
Whangarei	10·65	15	2·36	3·63
Auckland	4·04	12	1·06	2·59
Hamilton	5·24	20	1·10	3·70
Kawhia	5·05	19	1·20	3·37
New Plymouth	5·06	17	1·13	4·32
Riversdale, Inglewood	7·64	15	1·80	7·43
Whangamomona	6·84	20	2·33	5·82
Tairua, Thames	3·90	8	1·84	4·12
Tauranga	5·37	11	1·55	4·40
Maraehako Station, Opotiki ..	6·38	10	1·48	2·87
Gisborne	1·81	9	0·67	2·77
Taupo	4·64	11	1·45	3·46
Napier	1·25	13	0·37	2·44
Maraekakaho Station, Hastings ..	1·62	12	0 46	2·29
Taihape	3·28	16	0·76	3·03
Masterton	1·25	8	0·30	2·62
Patea	5·06	15	1·12	3·38
Wanganui	4·13	11	0·90	2·84
Foxton	2·76	13	1·00	1·99
Wellington	3·08	13	0·68	3·30
South Island.				
Westport	6·03	20	1·63	6·80
Greymouth	10·42	20	1·81	9·04
Hokitika	12·40	19	2·34	9·87

RAINFALL FOR JANUARY, 1926—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
South Island—continued.				
	Inches.		Inches.	Inches.
Arthur's Pass	16·54	16	3·10	6·75
Ross	13·36	16	2·06	12·04
Okuru, Westland	14·51	16	3·01	12·86
Collingwood	10·05	20	3·58	6·95
Nelson	4·09	16	1·50	2·71
Spring Creek, Blenheim ..	1·73	14	0·72	2·22
Tophouse	6·62	15	2·05	5·16
Hanmer Springs	3·04	15	0·80	3·30
Highfield, Waiau	1·74	10	0·40	2·84
Gore Bay	1·11	9	0·40	2·47
Christchurch	1·67	14	0·78	2·21
Timaru	0·94	10	0·56	2·28
Lambrook Station, Fairlie ..	1·68	5	0·66	2·34
Benmore Station, Omarama ..	4·36	9	1·87	2·66
Oamaru	1·33	12	0·63	2·15
Queenstown	2·34	9	0·60	2·71
Clyde	2·36	6	0·70	1·72
Dunedin	2·41	13	0·67	3·41
Gore	2·96	13	0·90	3·34
Wendon	3·61	8	1·53	3·52
Invercargill	2·64	15	0·62	4·14
Puysegur Point	12·06	19	1·82	7·22

CLASSIFICATION OF CATTLE IN NEW ZEALAND.

FOLLOWING are particulars of cattle in the Dominion (including boroughs) for the last two years' enumeration, as compiled by the Census and Statistics Office :—

—	Number on 31st Jan., 1924.	Number on 31st Jan., 1925.
Bulls two years old and over, for stud—		
For beef purposes	12,136	12,679
For dairy purposes	46,798	47,141
Steers two years old and over*	433,575	405,768
Steers and bulls one and under two years old	189,569	189,801
Cows and heifers two years old and over, for dairying—		
In milk	1,167,914	1,178,504
Dry	124,372	124,625
Other cows and heifers two years old and over ..	487,651	518,284
Heifers one and under two years old ..	438,084	441,510
Calves (heifer, steer, and bull) under one year old	630,130	552,164
In boroughs, &c.	33,268	33,268
Totals	3,563,497	3,503,744

* Including bulls not kept for stud purposes.

Eggs and Egg-pulp in Cold Storage.—The Government Statistician gives the result of the collection of this information at 31st December, 1925, as follows : Eggs in shell, 34,962 dozen ; egg-pulp, 912,476 lb. ; frozen whites, 556 lb. ; egg-yolk, nil.

ESTIMATED YIELDS OF WHEAT AND OATS.

THE following estimated average yields per acre of wheat and oats for the season 1925–26 have been compiled by the Government Statistician from reports furnished by Inspectors of the Department of Agriculture throughout the Dominion, and issued under date 9th February, 1926 :—

District.	Wheat. Bushels per Acre.	Oats. Bushels per Acre.
North Island	26·45	28·84
Nelson	19·05	24·01
Marlborough	29·86	34·43
Canterbury	28·85	33·39
Otago	32·69	42·59
Southland	33·55	43·10
Average (estimated) for the Dominion, season 1925–26	29·06	35·83
Average (actual) for the Dominion, season 1924–25	32·62	38·72

In accordance with the above estimates, the total yield of wheat for the Dominion should be approximately 4,600,000 bushels, as against an actual yield of 5,447,758 bushels for the season 1924–25.

The percentage of oats threshed for the five seasons ending with 1924–25 was 26·95 of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be approximately 3,700,000 bushels, as against an actual yield of 5,707,174 bushels for the season 1924–25.

FOREST AND TIMBER INSECTS IN NEW ZEALAND.

A VALUABLE publication bearing this title has recently been issued by the State Forest Service as Bulletin No. 2, the author being Mr. David Miller, Entomologist to the Department of Agriculture. In its seventy-six pages of printed matter the bulletin covers a wide field, treating of forest conditions, the importation of insect-infested timber, control, &c., in addition to dealing with over a hundred species of insects. Appended to the text are some hundred and fifty illustrations, a number of diagrams, and several maps. A section of the bulletin, together with several illustrations, is reprinted elsewhere in this issue of the *Journal*, and indicates the quality of the work. The price of the publication is 4s., including postage.

FORTHCOMING AGRICULTURAL SHOWS.

Rotorua A. and P. Association: Rotorua, 19th and 20th February.
Buller A. and P. Association: Westport, 19th and 20th February.
Northern Wairoa A. and P. Association: Mititai, 20th February.
Waiapu P. and I. Association: Ruatorea, 23rd and 24th February.
Tauranga A. and P. Association: Tauranga, 24th February.
Ohura A., P., H., and I. Association: Nihoniho, 25th February.
North Kaipara Agricultural Association: Paparoa, 25th February.
Franklin A. and P. Association: Pukekohe, 26th and 27th February.
Omaha and Pakiri A. and H. Association: Leigh, 27th February.
Taranaki Metropolitan Agricultural Society: New Plymouth, 3rd and 4th March.
Waikato Central A. Association: Cambridge, 3rd and 4th March.
Opotiki A. and P. Association: Opotiki, 9th March.
Morrinsville A. and P. Society: Morrinsville, 10th March.
Hawke's Bay A. and P. Society: Autumn Show, Tomoana, 16th and 17th March.
Mayfield A. and P. Association: Mayfield, 20th March.
Methven A. and P. Association: Methven, 25th March.
Temuka and Geraldine A. and P. Association: Winchester, 25th March.